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DESIGNING DESIGN SYSTEMS

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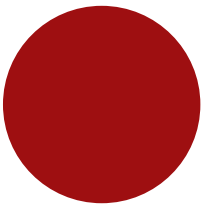

DESIGNING DESIGN SYSTEMS

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LIST OF ABBREVIATIONS

AEI. . . . . Artificial Emotional Intelligence
AGI. . . . . Artificial General Intelligence
AI. . . . . Artificial Intelligence
BCIs. . . . . Brain-Computer Interfaces
B2B . . . . . Business-to-Business
CTA. . . . . Call-to-Action
DIY. . . . . Do It Yourself
DIM. . . . . Design Identity Manual
DMs. . . . . Diffusion Models
EG. . . . . Evolutionary Growth
EV. . . . . Electric Vehicle
Fib. . . . . Fibonacci
fMRI. . . . . Functional Magnetic Resonance Imaging
GDS. . . . . Global Design System
GPT-4. . . . . Generative Pre-trained Transformer V4.0
GUI. . . . . Graphic User Interface
HCI. . . . . Human-computer interaction
HCIS. . . . . Human Computer Interaction System
ID. . . . . Identification
IoT. . . . . Internet of Things
IxD. . . . . Interaction Design
KCC. . . . . Krebs Cycle of Creativity
KPIs. . . . . Key Performance Indicators
LDMs. . . . . Latent Diffusion Models
MVP. . . . . Minimum Viable Product
NPM. . . . . Node Package Manager
QA. . . . . Quality Assurance
SER. . . . . Seeding, Evolutionary Growth, and Reseeding
SoT. . . . . Single Source of Truth
SPS. . . . . Spaceship ©
SQuaRE. . . . . Systems and software Quality Requirements and Evaluation
ToV. . . . . Tone of Voice
UCD. . . . . User-centered Design
UI. . . . . User Interface Design
UX. . . . . User Experience Design
VISF. . . . . Visual Impact Scale Framework
WCAG. . . . . Web Content Accessibility Guidelines
WIMP. . . . . Windows, Icons, Menus, Pointing device
W3C. . . . . World Wide Web Consortium

LIST OF FIGURES

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ABSTRACT

This work focuses on the ability to build, map and catalyze creativity through design systems where the interrelating capacity of different individuals, tools, and processes are in the context of larger systems or networks of influence. It aims to understand the construction of such systems and the dynamic rearrangement and distribution of spontaneous end-to-end paths once a meaningful change is introduced and consequently propagated through these systems or networks. It will be argued that the fabric of these systems is dynamic and ever-changing, and so is the development roadmap of the teams involved. We can say it's a living product, with an open-ended development framework.

Through this text, we'll approach a possible development framework based on a non-linear progression of communication systems aiming to produce and provide guidelines to individuals and teams from different disciplines and cultures toward an optimal production process. Also, we'll look with some detail at the operational aspects of the expected output of contributions and ultimately the outcome of such methodologies, first; on the end user that will use the product and services that are fundamentally and technologically impacted by such frameworks; second, the contributors and teams of contributors who build and use the systems to produce their work which

also is impacted by the implementation and execution of such methodologies.

An analysis of the creative impact at the individual level of the contributor should be expected in the context of such systems, the role of the designer in injecting new creative value through such networks of individuals and methodologies, and the consequences that these continuous feedback loops have at evolving and scaling these systems.

The concept of a system in these creative environments should be understood and the notion of metadesign applied to the architecture(s) and interdependence(s) of these development environments. At a low level, we should understand what a design system is and what its origins are, as well as predict and propose points of evolution having possible starting points like e.g. atomic design and systems thinking.

Questioning and expanding the concept of what a design system is, should be understood as the main contribution to this dissertation. To this end, we will also look, briefly, at what design systems have been in recent decades.

RESUMO

Este trabalho centra-se na capacidade de construir, mapear e catalisar a criatividade por meio de sistemas de design nos quais a capacidade de inter-relação de diferentes indivíduos, ferramentas e processos está inserida em contexto de sistemas maiores ou redes de influência. O objetivo é compreender a construção desses sistemas e o rearranjo dinâmico tal como a distribuição de caminhos espontâneos de ponta a ponta uma vez que uma mudança significativa é introduzida e consequentemente propagada por esses sistemas ou redes. Argumentaremos que a estrutura desses sistemas é dinâmica e em constante mudança, assim como o planeamento de desenvolvimento das equipas envolvidas. Podemos dizer que é um produto vivo, com uma "framework" de desenvolvimento em aberto.

Através do texto, abordaremos um possível "framework" de desenvolvimento baseado numa progressão não-linear de sistemas de comunicação, visando produzir e fornecer diretrizes para indivíduos e equipas de diferentes disciplinas e culturas em direção a um processo de produção optimizado. Também analisaremos com algum detalhe os aspectos operacionais da produção esperada e, em última análise, o resultado dessas metodologias. Primeiro, no utilizador final que utilizará o produto e os serviços que são impactados fundamentalmente e tecnologicamente por tais frameworks;

segundo, os contribuidores e equipas de contribuidores que constroem e utilizam os sistemas para produzir seu trabalho, o qual também é impactado pela implementação e execução dessas metodologias. Uma análise do impacto criativo em nível individual do colaborador deve ser esperada no contexto desses sistemas, assim como o papel do designer na introdução de novo valor criativo através dessas redes de indivíduos e metodologias, e as consequências que esses ciclos contínuos de feedback têm na evolução e escalabilidade desses sistemas.

O conceito de sistema nesses ambientes criativos deve ser compreendido e a noção de metadesign aplicada à arquitetura e interdependência desses ambientes de desenvolvimento. Num nível mais fino de detalhe, devemos entender o que é um sistema de design e quais são suas origens, além de prever e propor pontos de evolução com possíveis pontos de partida, como por exemplo o design atómico e o pensamento sistémico.

Questionar e expandir o conceito do que é um sistema de design deve ser entendido como a principal contribuição desta dissertação. Para isso, também faremos uma breve análise do que foram os sistemas de design nas últimas décadas.

INTRODUCTION

One should look into systems thinking and differentiate it from the concept of creative system thinking. The first of these approaches a concept originated in 1956, when the Systems Dynamic Group was created by Professor Jay W. Forrester at the Sloan School of Management at MIT, looking at "how the different parts of a system interrelate and how systems work within the context of other, larger systems",[1] and developing a holistic approach to analysis and problem-solving.

Creative system thinking, on the other hand, looks into creativity and the mechanisms to enhance outcomes on collaboration from creative practices, ultimately, to highlight aspects like the joy and power of collaboration.

Also, practices of "metadesign as an emergent design culture, calling for an expansion of the creative process in the new design space engendered by information technologies."[2]

This work's approach focuses on the ability to understand and catalyze creativity through systems where this interrelating capacity of different parts, tools, and heuristics at work are in the context of larger systems or networks of creative and non-creative contributors. To understand the dynamic rearrangement and distribution of spontaneous end-to-end paths once a meaningful change is introduced and consequently propagated system(s) wide, with this changing the very fabric of the system(s) it is being evolved and

1. CFI Team. n.d. "Systems Thinking." Corporate Finance Institute. Accessed November 16, 2022. https://corporatefinanceinstitute.com/resources/management/systems-thinking/.
2. Giaccardi, Elisa. 2005. "Metadesign as an Emergent Design Culture." Leonardo 38 (4): 342–49. https://doi.org/10.1162/0024094054762098.

Creativity can be viewed from many different perspectives. They are interconnected in a system that reinforces each of them.[3]

therefore a meaningful outcome for the initial requirements and constraints being produced by/for the system(s) architects or stakeholders is being targeted.

Hector Ramos, is a researcher and professor in the field of creativity and innovation. His work combines cognitive and psychological perspectives to understand the creative process and its relationship with society and time. In terms of creative methodology, Ramos focuses on understanding the cognitive and emotional processes that underlie the generation of new ideas and solutions. He also examines the role of motivation, emotions, and personality traits in the creative process.

For creative output, Ramos is interested in how creative ideas are evaluated and translated into successful products, services, and solutions. He also examines how cultural and societal factors influence what is considered creative and valuable in different contexts.

Ramos also examines the relationship between society and the creative endeavor, and how societal changes and historical context shape the way we think and create. He also considers how technology and globalization are affecting the way we create, share and evaluate ideas. This author's approach seeks to provide a holistic understanding of creativity by considering the various factors that influence the creative process, including cognitive, psychological, sociocultural, and historical factors. He also considers how

3. Ramos, Hector. 2013. "Creativity and Systems Thinking." In Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship, edited by Elias G. Carayannis, 389–91. New York, NY: Springer. https://doi.org/10.1007/978-1-4614-3858-8_53.

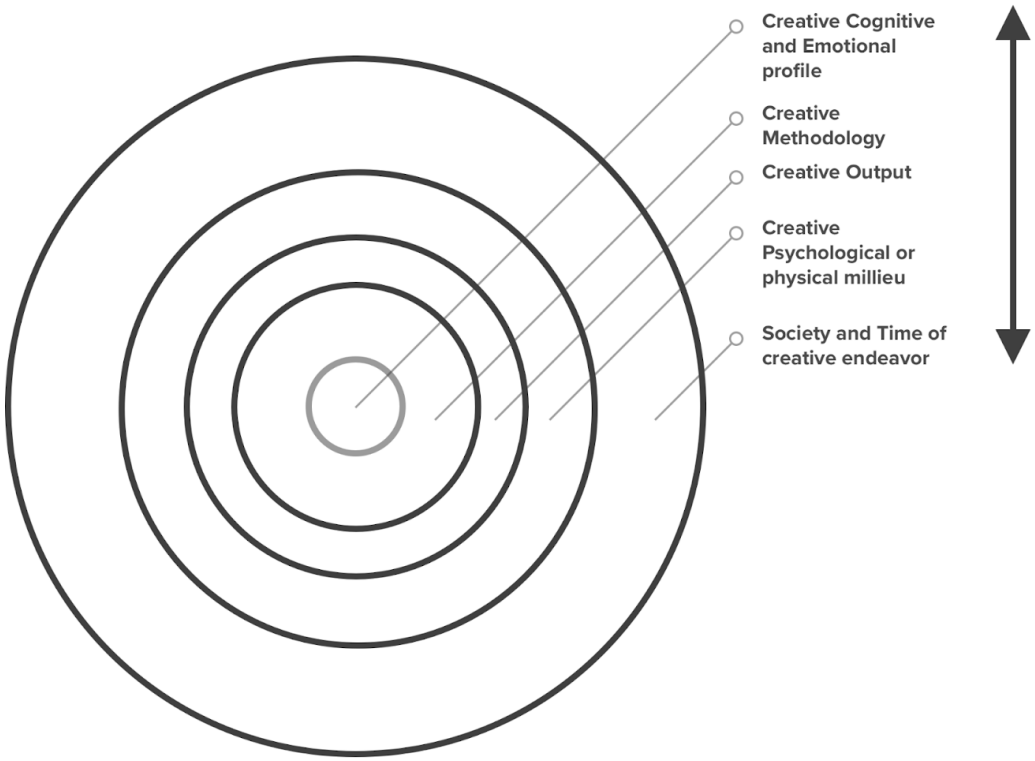


Figure 1.
Creativity: an evolving system[4]

these factors interact and contribute to the creative output, and how these outputs are valued by society and time.

Such relationships and understanding is of center interest in the construction of this text, under the boundaries of the discussed Global Design Systems. Figure 1, is a visual representation of the discussed holistic approach to creativity by the mentioned author.

4. This structure is based on the work of Ramos, Hector. 2013. "Creativity and Systems Think ing." In Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship, edited by Elias G. Carayannis, 389–91. New York, NY: Springer

THE DESIGNER

The relevance of the role of the designer affirms the capacity and a humanist property of this agent of change and reinforces its centrality in mechanisms that very often are still supported in paradigms of mass production, where teams and individuals are considered only for their output produced and delivered in an immutable chain or flow and without access to dynamics that provide reflection and redesign of these same chains or flows. It is therefore central to the research, findings for a detailed understanding and references for possible answers, and to think beyond output, but rather to outcome.

For this, it is necessary to conceive and understand the role of this agent beyond a simple service provider, as suggested by Ellen Lupton, who amplifies this position and "the desire to encourage designers to produce content and work in an entrepreneurial way and not just simply reacting to problems and tasks posed by customers. The word author suggests agency, intention, and creation, as opposed to the more passive functions of consulting, styling, and formatting."[5]

If, on the one hand, this singular impulse is essential to undertake with critical thinking, to not only react, it is nevertheless necessary to observe that in collaborative systems, such as those that will be discussed, this role takes on new silhouettes.

When in a network, and an integral part of a systemic fabric, how is this authorial and singular spirit of a creative agent fostered? What implications and dependencies can be formed that allow the propagation of decision-making with value for the network and not only for the individual?

5. Lupton, Ellen. 2012. "Designer as Producer." Walker Art Center, January. p. 13. https://www.academia.edu/44034472/Designer_as_Producer.

It will be advantageous to understand how these agents move in a unique way, creating their creative micro-processes of injection of value to, thus, contribute collectively following guidelines and good practices of the ecosystem in order to guarantee that there is no entropy, disruption and/or blocks on the value propagated by this same system and consequent outcome.

The focus of this analysis will be on the ability to bring to light the definition of this central role and the humanistic and creative properties of these agents, who, despite having these qualities as individuals, when part of production systems may be influenced by automatic and routine aspects of environments and systemic processes. How to guarantee the best response to this possible point of view?

Throughout this text, and by diving into more details about process and exploration, i.e., a behavioral heuristic model for individuals or teams, possible answers can be posed and argued as ways forward to foster and maintain this authorial impulse that is triggered by the individual in collective environments. The individual depends on the collective to be able to achieve far greater results than ever before in such environments, the greater the understanding and connection throughout multiple touch points in the design and build processes, the greater the value of the input of the individual.

A *continual synergy* of individual/collective is one of the fundamental premises explored in this work. The designer, in this context, is the agent with the role of bridging such a

multidisciplinary and multicultural
fabric of agency.

Systems have several common properties and characteristics, including structure, function(s), behavior and interconnectivity.[6]

WHAT IS A SYSTEM

A system is a collection of interconnected components that work together to achieve a common goal or set of goals. The components of a system can be physical, such as the parts of a car, or they can be abstract, such as the ideas and institutions that make up a society. Systems can be simple, such as a flashlight, or they can be complex, such as a human body or a city.

Systems can be open or closed. Open systems can exchange matter, energy or information with their environment, while closed systems do not. These interconnected components can also be classified as natural or artificial. Natural systems are found in nature, such as the solar system and an ecosystem, while artificial systems are created by humans, such as a computer system or a transportation system.

In general, a system has an input, a process, and an output. The input is the information, matter or energy that the system receives. The process is the operation the system performs on the input. The output is the result of the process, the information, matter or energy that the system delivers.

Examples of systems include:

- A transportation system, which consists of roads, vehicles, and traffic regulations, and is designed to move people and goods from one place to another.
- A computer system, which consists of hardware, software, and data, and is designed to process information.
- A solar system, which consists of the sun and the celestial bodies that orbit it, and is held together by gravity.

6. Backlund, Alexander. 'The Definition of System'. Kybernetes 29, no. 4 (1 January 2000): 444–51. https://doi.org/10.1108/03684920010322055.

- An ecosystem, which consists of living and non-living components, such as plants, animals, water, and soil, and is defined by the relationships and interactions between these components.
- An economic system, which consists of the institutions and processes by which a society produces and distributes goods and services.

It's important to note that systems can be nested within other systems, and can interact with other systems. For example, a city is a system that is made up of many smaller systems, such as the transportation system, the water system, and the power grid, and interacts with other systems such as the regional ecosystem and the global economy.

For the purpose of this work, the goal is to explore artificial systems, with such interdependencies or nested sub systems, such as those of design language systems, that are specifically used in technology information and communication design fields to create a consistent visual and user experience across a range of products or digital platforms and digital *ecosystems*.

The use of the word ecosystem in the context of technology and information, refers to a network of interconnected components that work together to support a specific technology or area of the technology industry. These components can include hardware manufacturers, software developers, service providers, and users.

An ecosystem can take many forms, such as:

- A software ecosystem, which includes the operating system, applications, and developers that build on top of it.

Examples include the Apple iOS ecosystem and the Android ecosystem.

- A hardware ecosystem, which includes the devices and accessories that work with a specific platform or technology. Examples include the Apple ecosystem of iPhones, iPads, and Macs and the Amazon ecosystem of Echo devices and Kindles.
- A platform ecosystem, which includes the platform, the developers that build on top of it and the users that use the platform. Examples include the Apple App Store ecosystem, the Google Play ecosystem and the Amazon Web Services ecosystem.

Within this macro view of groups of systems, ecosystems play a key role in driving innovation and growth in the technology industry. Bridging such rich and wide groups of information complexity, is often the role of smaller intersecting systems, that provide frameworks for designers and developers to build new products and services, and for users to access, meaningfully, and use those products and services. We'll be diving into more detail in such intersections, as they create a network of actors that can work together to solve problems and create new opportunities, which can lead to the development of new and improved products and services.

A VERY BRIEF HISTORY OF THE ORIGINS OF SYSTEMS IN COMMUNICATION

Systemic communicational problem-solving techniques can be first observed, meaningfully and for the context of this text, in the form of the written alphabet.

From its invention dating back to the 1900s BCE or even earlier[7], and evolving from ideograms, the characters soon achieved a stable formalization. The potential and exponential abstractions from the combined modules, the characters, would form words, and these words would have as an outcome results such as natural language, poetry, scientific documentation, computer code, and hypertext, to express a few forms of this instrumental and foundational communication tool.

In the Middle Ages, artisans and craftsmen used *guild marks* as a means of identifying their work. These can be considered the first manifestations of identity marks, *proto-logotypes*, and served as a symbol of the individual's trade or profession.

The use of heraldic symbols[8], such as *coats of arms* and *family crests*, during the same time period is also an early manifestation of such necessity of *systemic symbolism* and shared meaning. These symbols represented noble families and were a *symbol of power and prestige*.

Religious symbology also played a significant role in early systems of communication, as seen in the continued use and significance of symbols such as the *cross* in Christianity, which remains an important symbol of the faith today. Even before this direct symbolism as denoted by the *cross*, another earlier example of meaning attribution can be the symbol of the *fish*. Known as the *Ichthys symbol*, it has a long history of use as a representation of the Christian faith. The word "Ichthys"

7. 'The Origin of the Alphabet'. Accessed 10 January 2023. http://webspace.ship.edu/cgboer/alphabet.html.
8. Eskilson, Stephen J. *Graphic Design: A New History*. First Edition. New Haven: Yale University Press, 2007.

is Greek for "fish,"[9] and the symbol is composed of two intersecting arcs that form a fish shape. The earliest examples of the Ichthys symbol date back to the first few centuries of the Christian era and were used by early Christians as a secret symbol to identify themselves and as a way to spread their message without drawing attention to themselves.

The transition from oral to written language marks a significant moment in human history, as it allows for the preservation, therefore further generational reach, of language and culture through written records. Havelock writes[10] about the transition from oral cultures to written cultures in ancient Greece and the important role played by *symbols* in this transition. With the advent of writing, symbols became more important as a means of representing ideas, objects, and concepts in a more concrete way. In particular, the author notes the important role played by the development of syllabic and alphabetical writing systems, which made it possible to record and transmit information in a more flexible and efficient manner.[11] This shift from orality to literacy, changed the nature of communication.[12] Preserving ideas, making them available to larger audiences and more susceptible to analysis and critique, and further scala

The next notable advancement in the amplification and dissemination of knowledge through language was the invention of the movable type

9. Ferguson, George, and George Wells Ferguson. Signs & Symbols in Christian Art. Oxford University Press, 1961.
10. Havelock, Eric A. Preface to Plato: Cambridge, MA: Belknap Press, 1982.
11. Havelock, Eric A. The Literate Revolution in Greece and Its Cultural Consequences. Princeton University Press, 1982. https://doi.org/10.2307/j.ctvbcd1d2.
12. Ong, Walter J. Orality and Literacy: The Technologizing of the Word. New Accents (Methuen & Co.). London: Methuen, 1982. http://www.gbv.de/dms/bowker/toc/9780416713701.pdf.

The first official newspaper, Relation, was printed and distributed in Strasbourg. Newspapers appeared all across Europe, formalizing the printing press' contribution to the growth of literacy, education and the far-reaching availability of uniform information for ordinary people.[13]

by Johannes Gutenberg. This innovation applied modular and systematic principles to printing, allowing for the mass production of written language in a standardized and efficient manner.

This reproduction or serialization of texts e.g. in the form of books, and newspapers, should be seen, perhaps, as one of the first manifestations of production lines in history.

As a matter of fact, we should look into this production and consequent reproduction of a single artifact, with a specific assemblage process and methodology as to specific hardware and machinery as a manifestation of systemic problem-solving. So, the artifact's final form or output is a consequence of production requirements and constraints where every piece of a subsystem is calibrated and measured to function alone or in clusters. Modularity, one of the attributes of moveable type, enables optimization and reusability. Also, it enables the possibility of collaboration, so multiple editors can assemble one artifact working in choreography using shared standards and rules.

In a newspaper, the format of the paper artifact is also a system by itself, using the constraints and dimensions of the printing press as to the attributes of the moveable metal type characters and ink features to be able to receive this transfer from the press, with high pressure, without breaking apart and after receiving to be able to maintain the quality for distribution and readability for the final user.

13. Editors, History com. 'Printing Press'. HISTORY. Accessed 10 January 2023. https://www.history.com/topics/inventions/printing-press.

This interdependence and interrelation of systems, working for the same unified goal, is of central interest in this text.

1. CREATIVE VISION

The use of the word *vision* implies that an epiphany or sequence of epiphanies has occurred. This hints that for a sequence of events, such as user and market research, understanding a clear need from a user or community, the crystallization of a problem has produced the opportunity of a response to a very specific question. A *why* something should be made and *how* something can be solved for. Having this opportunity to clearly see a path for a resolution, or direction, should be seen as a seed to start developing a strategy to build from.

After formulating a strategy and having a clear understanding of where to go and what the priorities are, strategy execution should be seen as the next step; "translating the vision and goals into actions".[14]

It's from strategy, and from the real necessity to operationalize concepts into action that the following initiative, a Global Design System, emerges.

14. Kawas, Dana. '(24) How to Translate Your Vision into Action? | LinkedIn'. Accessed 16 November 2022. https://www.linkedin.com/pulse/how-translate-your-vision-actions-dana-kawas/.

1.1. GLOBAL DESIGN SYSTEM

Global Design System, addresses a general development framework progression on which such systems can be built. We'll argue that this progression is non-linear, recursive, and highly iterative. This Global Design System represents a group of foundations, systems, and teams that are used as a base upon which other teams, processes, designs, and technologies are developed and shared.

Functional groups (teams) can be seen as individual nodes of a network that can create deliverables asynchronously and independently. So, if any information displayed in Figure 2 is modified, at any given section, it can be incrementally and iteratively propagated without any need to stop or block any existing connection from each section.

More detail about the sequencing and build of Figure 2 can be consulted in the paragraphs below closing this section.

Furthermore, due to the lack of full context of challenges or problems to solve, and due to the quick re-arrangement of such networks in order to provide short-term answers for quick progression, the flexibility is an expected requirement for the individual and teams involved.

The Figure, *Global Design System — Architecture*, represents in a simplified form a comprehensive framework that needs to be built in layers with independent branches of development, to ensure that it is scalable, modular, and can be

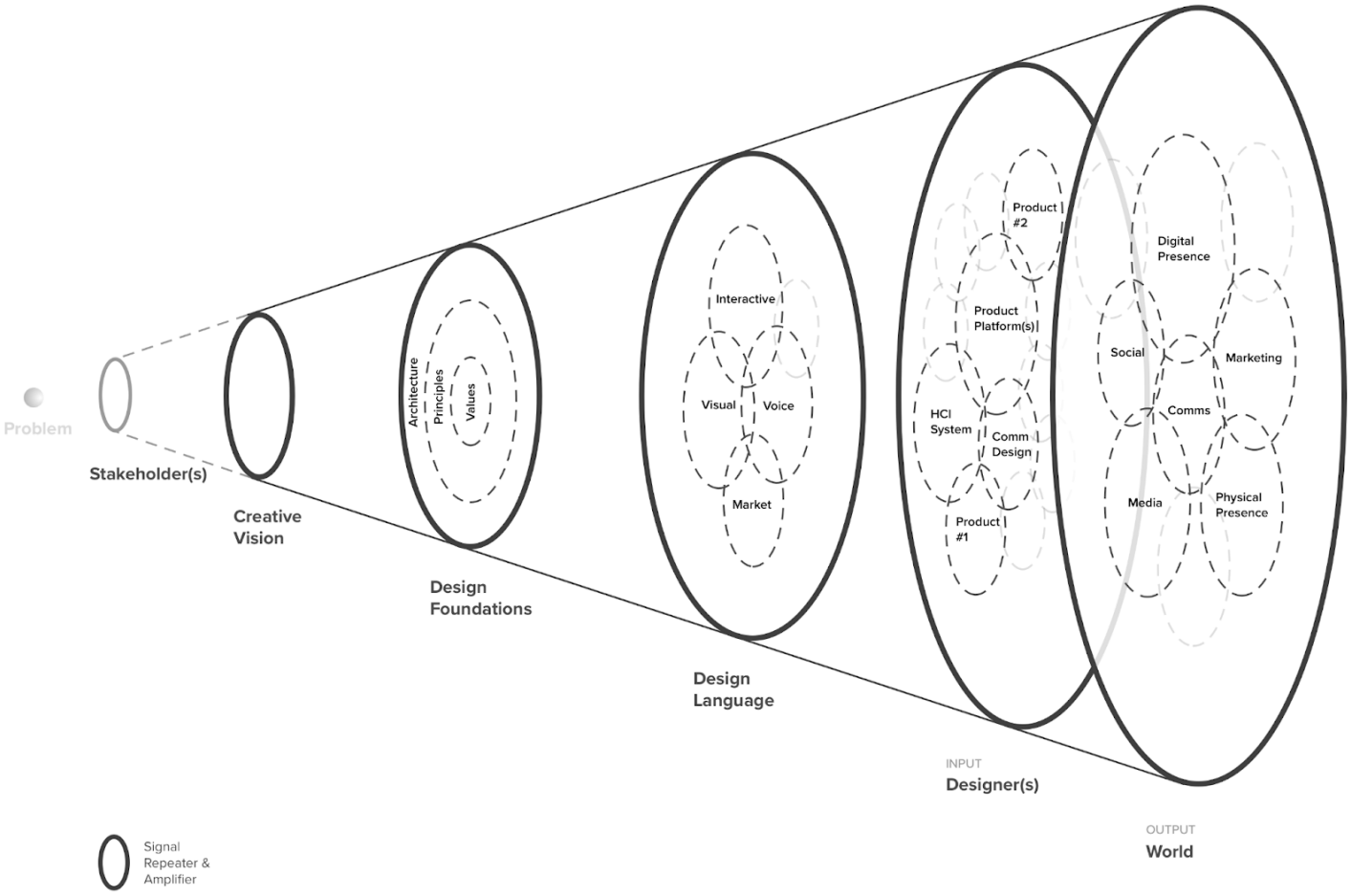


Figure 2.

Global Design System — Architecture

iterated effectively. These various layers solve a problem or catalyze a *change*, systematically.

The foundational layer is the origin or catalyst, which represents the *Problem* that needs to be solved. This layer sets the context for the entire system and ensures that all subsequent layers are aligned with this foundational problem.

The *Stakeholders* layer comes next and represents the why and what is there to be achieved. This layer defines the purpose and goals of the global design system and identifies the key stakeholders who will benefit from it. This layer helps to define the objectives and goals of the system.

The third layer is the *Creative Vision* layer, which represents the how goals are achieved. This layer defines the creative vision and outlines the operational principles that guide the design process, such principles as systemic, modularity, iteration, and scalability. It provides a clear direction on how to approach the problem and achieve the desired outcomes.

The *Design Foundations* layer follows, where the system is organized with a brand architecture, principles, and values definition. This layer defines the

identity of the system and provides a framework for the creative vision to be realized and provides a structure for organizing the system.

From the previous layers, the *Design Language* layer is developed, which serves as a platform for exploring and expressing various communication fields such as interactive, visual, voice, and market. Each of these fields triggers specialized workstreams and dedicated professionals that work synchronously and asynchronously, linearly and nonlinearly from a foundational and independent set of principles formed from the creative vision operational and creative heuristics pillars.

The *Input* layer comes next, where specialized work streams are created to develop sub-systems for and with internal consumers' contribution, validation, and feedback injection. This layer ensures that the global design system is optimized and tailored for the users' needs and that feedback is incorporated into the design process.

Finally, the *Output* layer represents the *world*, or external corporate environment, where the outcome of the global design system reaches end-users, communities, markets, and more. This layer addresses digital and physical presences, social networks, multimedia, and hypermedia. Feedback from this layer is injected back into the system to ensure that it can

respond and evolve in a modular and scalable way.

This text proposes that by building a Global Design System at the light of such a framework, organizations can create a cohesive and effective approach to design that aligns with their strategic goals and engages stakeholders at every step of the process. Doing so by applying a high degree of independence, autonomy, and self-service mindset to individuals and teams involved in such processes yet maintaining decentralized, cohesive and diverse creative ecosystems.

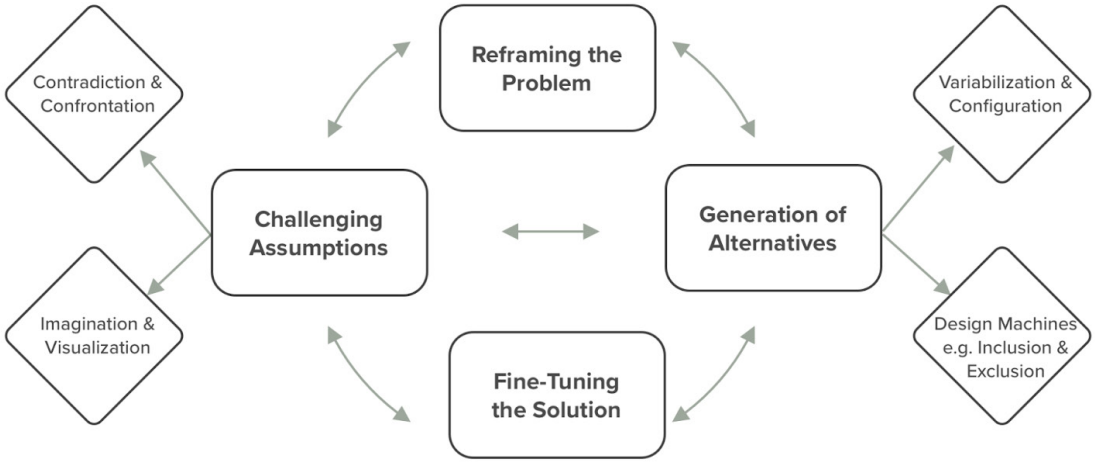


Figure 3.

A framework of Creative Heuristics[16] with augmented subroutines

1.2. A CREATIVE ECOSYSTEM

Individuals and teams are nodes in an ecosystem. Each team has connection pieces, their individuals, that enable communication with all functional parts of this network. This Global Design System drives how these connections are established and maintained throughout multiple endpoints, through multiple disciplines, ultimately arriving externally to end-users.

These are the foundations to concrete and actionable methodologies for every contributor and user of these systems. So each individual can easily start to conceptualize and build work with a shared set of tools and methodologies. A self-service, do it yourself (DIY) toolkit that enables and accelerates the production of new ideas, artifacts and products in an orchestrated and optimized creative framework(s).

Design thinking methodologies "draw on logic, imagination, intuition, and systemic reasoning to explore the possibilities of what could be and to create desired outcomes that benefit the end-user"[15]

Creative heuristics, triggered by simple keywords or concepts, are used as vectors that should guide the initial decision-making process. The interlinked nature of these systems i.e. technology and design determines the necessity and usage of the following guiding and generic creative principles.

As a practical example, let's take the following keywords:

15. Naiman, Linda. 'Design Thinking as a Strategy for Innovation - Creativity at Work'. Https://Www.Creativityatwork.Com/ (blog). Accessed 13 January 2023. https://www.creativityatwork.com/design-thinking-strategy-for-innovation/.

16. Deckert 2023, p. 21. Inclusion & Exclusion sub routines are combinatorial principles discussed in Design Machines, Melo 2022.

Most people make the mistake of thinking design is what it looks like. People think it's this veneer – that the designers are handed this box and told, 'Make it look good!' That's not what we think design is. It's not just what it looks like and feels like. Design is how it works.[17]

1.2.1. POSSIBILITY

Render possible ideas, projects, and new realities. To be able to immediately understand and relate to what is seen. Making ideas happen is not so complicated and therefore feel empowered to take action.

1.2.2. FUNCTIONALITY

Balance, focus on the essential, purity, and simplicity.

Equal visual weight and importance in the elements used. A sense of stability and symmetry. *Scarcity*, by highlighting the most important aspects of the design, and eliminating any unnecessary elements. By focusing on what's truly important, the design can become more efficient, clear. Ultimately, *invisible*.

1.2.3. BEAUTY

Unconventional beauty.

"Beauty is more important in computing than anywhere else in technology because software is so complicated. Beauty is the ultimate defense against complexity".[18]

"The aesthetic quality of a product is integral to its usefulness because the products we use every day affect our person and our well-being. But only well-executed objects can be beautiful".[19]
In fact, this combination of aesthetic qualities produces the *aesthetic-usability effect*[20] that is characterized as a consumer's inclination to consider an attractive artifact easier to use in comparison to another that is not so attractive, this impact permits users to pardon trivial usability matters.

17. 'Jobs 2003 in Yau, Nathan. 'Steve Jobs on Design'. FlowingData (blog), 31 October 2008. jobs-on-design/.
18. Gelernter, David. Machine Beauty: Elegance And The Heart Of Technology. New York, NY: Basic Books, 1998.
19. Barry, Pascal. 'Deconstructing Dieter Rams' Ten Principles for Good Design — Part 1'. Medium (blog), 4 November 2020.
20. Nebukhadnezzar. 'Design Principles: Aesthetic-Usability Effect'. Medium, 21 August 2019.

Other frameworks or methodologies can be used, created, and deployed in subsystems, according to the area of specialty or discipline. An example is the design process pioneered by IDEO[21] and the Stanford d.school, this iterative process uses divergence and convergence again and again until a solution is met. Diverging is typically an ideation phase.

21. IDEO | Design Thinking. 'IDEO Design Thinking'. Accessed 13 January 2023

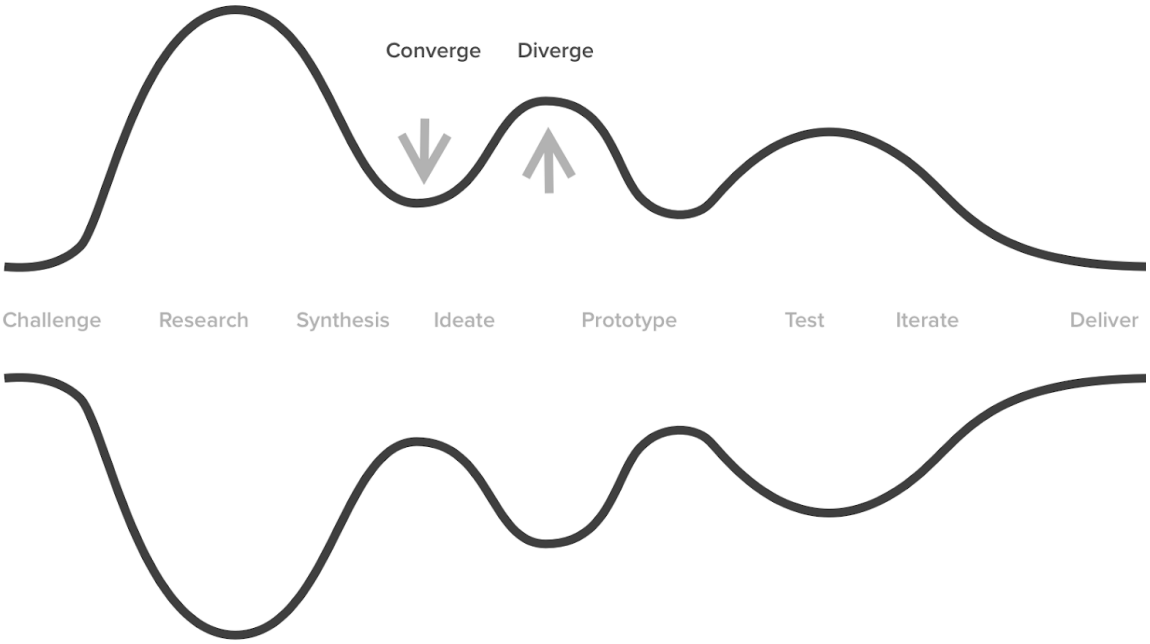


Figure 4.

Design process by IDEO

Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.[22]

22. Simon H., Nobel Laureate in Economics *in* Moore, Eric. 'Design Thinking Guidebook', 2022.

2. SYSTEMIC THINKING

In the modern tech development market, companies struggle with the intricacies of complex management experiences, that for multiple reasons can impact results for the end-user, while doing so by also having an impact on the contributors of such managed experiences.

This thesis approaches a set of methodologies that combined or working independently proposes to address such complexity, providing guidance to multiple contributors, ranging from stakeholders to end-point contributors. This orchestration of a design-driven proposed methodology, is a systematic problem-solving strategy that proposes metadesign thinking to provide tangible value to end users and their communities and eco and social systems, as indirect contributors, as to the direct contributors of such systems. Therefore, to effectively solve such complexity, metadesign architecture should start from a stakeholder layer, represented in Figure 2.

This identification and value of the discipline of design is a fundamental requirement to unlock every other process that will be discussed in this text. This is also one of the main pillars on which a creative vision is triggered, having a range and scope that in itself can transform a business model(s) and technologies involved in such models, products, and services.

Through the work, we'll make use of a holistic approach

"Design problems are "indeterminate" and "wicked" because design has no matter of its own apart from what a designer conceives it to be. The subject matter of design is potentially universal in scope, because design thinking may be applied to any area of human experience. But in the process of application, the designer must discover or invent a particular subject out of the problems and issues of specific circumstances. This sharply contrasts with the disciplines of science, which are concerned with understanding the principles, laws, rules, or structures that are necessarily embodied in existing subject matters."[25]

to understand and analyze complex systems by considering the interconnectedness and interdependence of the various components within a system, and how changes in one area can affect the entire system. We'll also focus on understanding the relationships between different systems and how they influence one another. The goal of systemic thinking is to identify patterns and connections that may not be immediately apparent in order to find effective solutions to problems.

2.1. A PROBLEM

At the very core of its foundations, there's a necessity that triggers a response for a resolution. One might look at this as a problem definition, which represents the core challenge(s) to solve for. It's also important to consider the concept of a wicked problem:

Wicked problems[23] are problems with many interdependent factors making them seem impossible to solve. Because the factors are often incomplete, in flux, and difficult to define, solving wicked problems requires a deep understanding of the stakeholders involved, and an innovative approach provided by design thinking.[24]

Design problems are "moving targets that have resolutions rather than solutions; and the context in which these problems exist is by nature characterized by change, conflict, and multiple

23. "The phrase wicked problems was borrowed from philosopher KarlPopper. However, Rittel developed the idea in a different direction. Rittel is another example of someone initially influenced by neo-positivist ideas who, when confronted with the actual processes of practical reasoning in concrete circumstances, sought to develop a new approach related to rhetoric." (Buchanan 1992, p. 16)
24. "What Are Wicked Problems?" n.d. The Interaction Design Foundation. Accessed November 30, 2022.
25. Buchanan, Richard. 1992. "Wicked Problems in Design Thinking." Design Issues 8 (2): 5. p. 16

stakeholders[26]. In many cases, the consensus is not achievable, and the best we can strive for is informed compromises emerging from the *symmetry of ignorance*[27"28]

Rather than seeing the shared lack of knowledge as a hindrance in the design process, we might view it as a chance to generate new knowledge and ideas — as C.P. Snow stated: "The clashing point of two subjects, two disciplines. two cultures of two galaxies, so far as that goes-ought to produce creative chances".[29] Having diverse perspectives can help uncover alternative solutions and shed light on the implicit aspects of problems.

Acknowledging that most design problems are marked by a shared lack of knowledge requires a different understanding of expertise and learning. In these situations, relevant knowledge does not already exist and cannot simply be transmitted from those who have it to those who need it. Instead, it must be extracted and synthesized from the various perspectives and expertise of the contributors.

Notions of deep understanding and the necessity of an innovative approach are then fundamental to start tackling such methodologies of problem-solving, and the invention of a particular subject directly related to a context and circumstances is indeed the rationale that will trigger the foundation and construction of the systematic framework explored in this document.

Confronted with such complexity, stakeholders are

26. Arias, Ernesto G. 1995. "Designing in a Design Community: Insights and Challenges." In Proceedings of the 1st Conference on Designing Interactive Systems: Processes, Practices, Methods, & Techniques, 259–63. DIS '95. New York, NY, USA: Association for Computing Machinery.

27. Rittel, H., and M. M. Webber. 1984. Planning Problems Are Wicked Problems. In Developments in Design Methodology. John Wiley and Sons, Inc., New York, NY, 135–144.

28. Arias, Ernesto, Hal Eden, Gerhard Fischer, Andrew Gorman, and Eric Scharff. 2000. "Transcending the Individual Human Mind—Creating Shared Understanding through Collaborative Design." ACM Transactions on Computer-Human Interaction 7 (1): 84–113.

29. Snow, C. P. 1993. The Two Cultures. Canto ed. London ; New York: Cambridge University Press. p. 16

informed by designers who should, through *Systems Thinking*[30] and other methodologies such as *Agile*,[31] develop strategies based on iterative approaches to design responses or solutions through collaboration. These responses should be efficient and effectively meet the stakeholders' and real-world ever-changing requirements and constraints.

2.2. DESIGN IS MORE THAN JUST "PROBLEM-SOLVING"

In the 19th and 20th centuries, businesses primarily relied on analytical approaches from scientific management and engineering to operate. However, these methods have proven inadequate in addressing the more complex issues faced by companies today. As a result, there has been an increased focus on design as a solution, for the following motivations:

- "Squeezing greater efficiency has run its course, and design's generative qualities are seen as a means to realize new business value.
- Given software's abstract nature, design is required to tether the experience to something people can understand; with networked software, this challenge is exponentialized.
- The shift from products to services, with umpteen touchpoints by which someone chooses to interact,

30. Systems Thinking is the process of capturing and understanding how components of a system influence each other as well as other related systems.

31. Agile is an iterative approach to project management and software development that helps teams deliver value to their customers faster and with fewer headaches. Instead of betting everything on a "big bang" launch, an agile team delivers work in small, but consumable, increments. Requirements, plans, and results are evaluated continuously so teams have a natural mechanism for responding to change quickly. (Atlassian 2022)

places greater reliance on design for coordination so as not to overwhelm the customer.[32]

Given this acknowledged value of design in solving for such complexity and abstraction, the design of such systems implies access to critical decision making, implies also the buy-in or sponsorship of main stakeholders in such processes. This alignment is critical and formally unlocks all system(s) layers represented in Figure 2.

With the formal decision to address a *problem*, the design triggers the creation of foundational principles to start:

The framework(s)

The team(s)

In this text, we'll be looking to design development work streams into greater detail, but it is fundamental to take into consideration that the involvement and intersection of other disciplines like e.g. engineering are crucial and a requirement to optimal system design. With this said, the creative vision is then triggered on intersection requirements that uphold notions of:

Operation

- Systems(s)
- Modularity
- Iteration
- Scalability

Creativity Heuristics

- Functionality
- Possibility
- Connections
- Beauty

32. Merholz, Peter, and Kristin Skinner. 2016. Org Design for Design Orgs. p.8

The challenge of design is not a matter of getting rid of the emergent, but rather of including it and making it an opportunity for more creative and more adequate solutions to problems. Metadesign is a conceptual framework defining and creating social and technical infrastructures in which new forms of collaborative design can take place.[33]

The creation of development streams of work based on requirements and expectations from stakeholders is kicked-off having a set of heuristics as guidance and following metadesign principles to converge a set of actions that emerge from quick calls to action and decision making processes that happen quickly and asynchronously throughout multiple and simultaneously end points of a proto-ecosystem in formation.

The first operational directive, system(s), starts by acknowledging a set of preexisting attributes that will form initial requirements:

- Findings and Challenges
- Frameworks
- Environments
- Applications

These attributes will inform and give clarity to the available set of decisions to trigger the following actions that should evolve the systemic fabric, with this scaling operational decisions to be made.

33. Fischer, Gerhard, and Elisa Giaccardi. 2006. "Meta-Design: A Framework for the Future of End-User Development." In End User Development, p. 5, edited by Henry Lieberman, Fabio Paternò, and Volker Wulf, 427–57. Human-Computer Interaction Series. Dordrecht: Springer Netherlands.

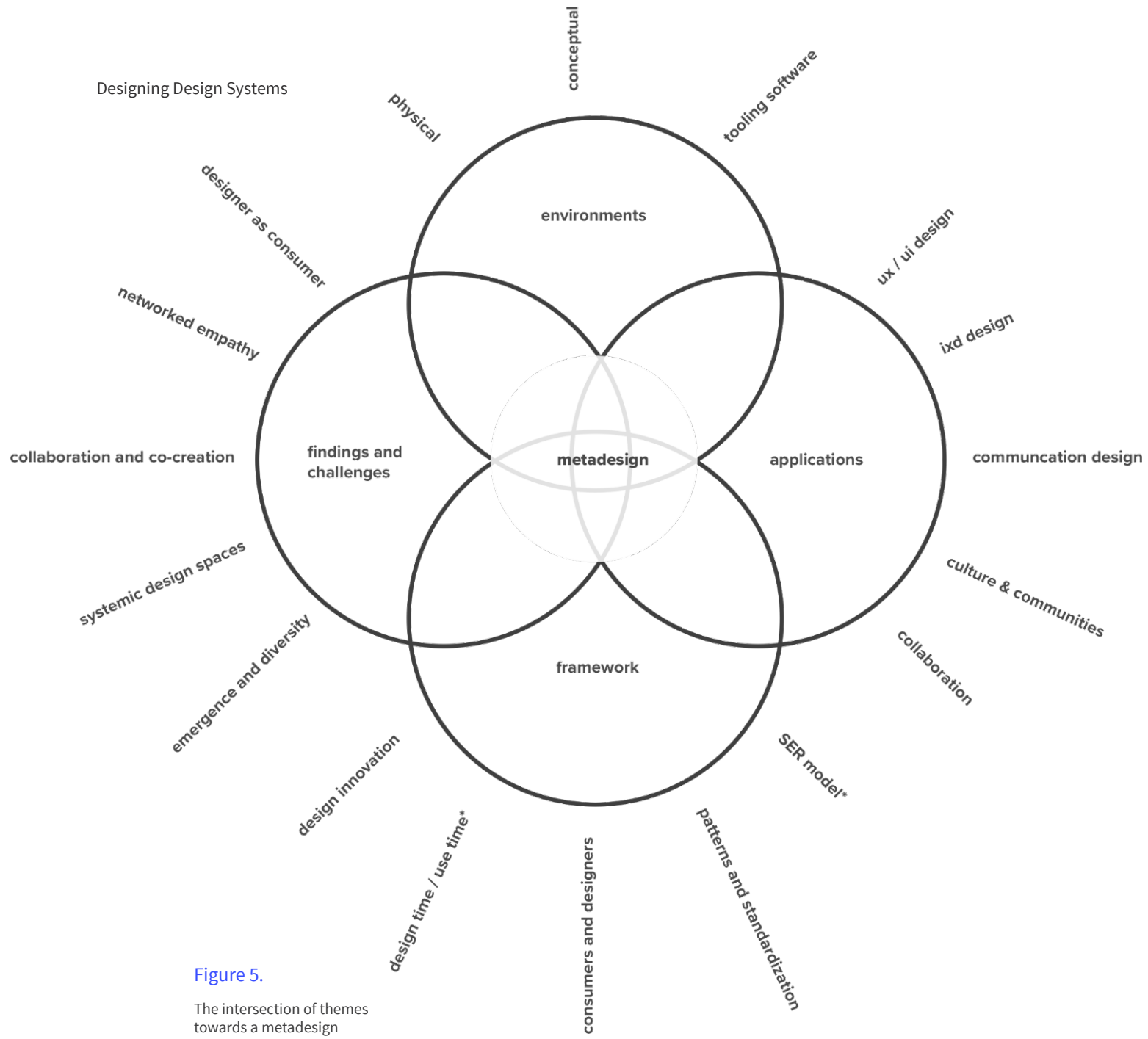


Figure 5.

The intersection of themes towards a metadesign framework[34]

2.3. METADESIGN

Metadesign is a conceptual framework to establish and develop social and technical infrastructure that enables collaborative design. This framework includes various design tools and processes to facilitate this goal. The methodology aims to promote the emergence of new and innovative ideas through the collaboration of designers from various disciplines in metadesign teams.

In design and engineering, developing environments

34. This content is inspired by the work of G. Fischer and E. Giaccardi "The structure of Our Contribution: How Themes Are Interrelated" Fischer and Giaccardi 2006, p. 4

where the unknown and the limitation of human resources to solve long-term strategies are a reality, is paramount to build foundations for such environments which account for consistency, scalability, evolution, and I would add, revolution.

Emergence and diversity are key to healthy creative environments, but also auto-sustainability and stability, which act in consonance and uphold the first attributes. In a constantly changing and unpredictable world, the ability to improvise, evolve, and innovate becomes essential, rather than a luxury. The task of design in such contexts is not to eliminate the unexpected, but rather to embrace it as an opportunity for more imaginative and effective problem-solving approaches.

Metadesign addresses the following "three necessities for socio-technical environments"[35] on which such systemic fabrics should thrive. Such networks:

1. Must be flexible and evolve because they cannot be completely designed prior to use.
2. Must evolve to some extent at the hands of the users.
3. Should be designed for evolution.

To move forward a notion of distributed cognition, through computational or non computational media we should therefore deploy operational models which enhance:

35. Arias, Ernesto, Hal Eden, Gerhard Fischer, Andrew Gorman, and Eric Scharff. 2000. "Transcending the Individual Human Mind—Creating Shared Understanding through Collaborative Design." ACM Transactions on Computer-Human Interaction 7 (1): 84–113.

1. Abstraction comprehension (the capacity to comprehend the structure and limitations of abstractions, language, and instrumental thinking);
2. Diagramming and topology (the application of diagrammatic thinking and design, supported by topological understanding);
3. Procedural design (the creation of situations or environments through the use of procedures, role-playing, providing guidance, and mentoring);
4. Adaptability to unexpected situations (the ability to cope with a lack of complete control and to make use of unintended and unforeseen outcomes).

2.4. OPERATION

From the necessity of symmetry of information and context between peers of the same operational units to multiple operational units, another challenge emerges from how to bring talent from the outside world to internal corporate spaces which have singular development cultures that need to be learned first. This cultural fit is in itself a pedagogical and operational challenge that should be part of the foundations of such systems, therefore all involved entities, i.e., stakeholders, Human Resources, are informed and intrinsic parts of the decision-making process to successfully onboard new blood into critical parts of the ecosystem. Not only is onboarding critical, but it's also a constant

effort to monitor and guarantee satisfaction levels as to expertise and even lifestyle factors to make sure this talent is able to properly evolve and grow professionally and personally with a leadership mindset. This mindset can be directed to manage other people or to the craft, to be an expert in a desired field. This effort should go even through offboarding, so when talent leaves these corporate spaces to join others they'll, hopefully, be better professionals and individuals.

2.5. SER MODEL

Adopting a metadesign approach, which prioritizes creating solutions that drive change, sustainability, and adaptability, requires a structured and systematic approach to ensure successful implementation of such practices.

Therefore, supporting metadesign with the "Seeding, Evolutionary Growth, and Reseeding (SER) Model"[36] is a reference, to achieve such structured principles.

The SER model[37] is a framework for designing systems that can adapt to changing environments. Rather than trying to create fully developed systems from the start, the SER model suggests building seeds that can grow and change over time. According to this model, successful systems that endure for an extended period must go through cycles of both planned

36. Carmi, Golan, and Dan Bouhnik. 2012. p. XXI "Experience, Knowledge and Previous Study in E-Learning Courses as Factors That Affect Development of Intellectual Thinking Dispositions in Online Learning."

37. Fischer, Gerhard, and Jonathan Ostwald. 2002. "Seeding, Evolutionary Growth, and Reseeding: Enriching Participatory Design with Informed Participation,"

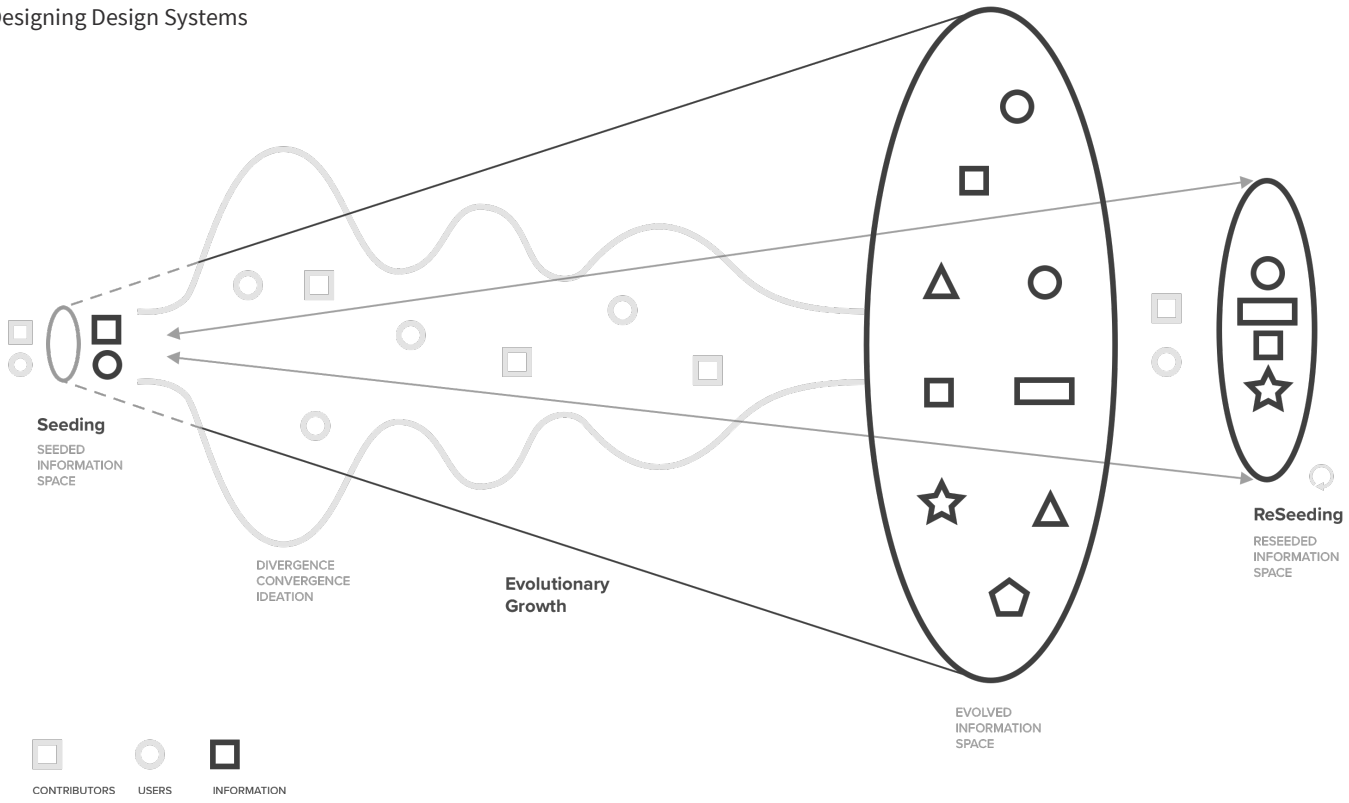


Figure 6.

Optimized SER framework in the context of new proposed system environment[38]

development and unplanned evolution, as well as periods of deliberate restructuring and improvement. This approach is both descriptive, describing how systems evolve, and prescriptive, providing guidance on how to create systems that are capable of evolving effectively.

From the reference work of Fischer and Giaccardi[39] the *Seeding, Evolutionary Growth, and Reseeding Process Model*, it's possible to apply and expand divergent and convergent ideation principles, foundational to systemic thinking and development. In such environments, we propose symmetric input/output from both contributors and users. This symmetry upholds open access to meaningful information injection in such environments, which can happen from both actors if they have the right context and ownership of problems through the life cycle of the necessary iterations implied in the evolutionary growth phase(s).

38. Carmi, Golan, and Dan Bouhnik. p. XXI

39. Fischer, Gerhard, and Elisa Giaccardi. 2006. P. 09 "Meta-Design: A Framework for the Future of End-User Development." In End User Development, edited by Henry Lieberman, Fabio Paternò, and Volker Wulf, 427–57. Human-Computer Interaction Series. Dordrecht: Springer Netherlands.

Creative development is the systematic growth in the creative capacity of an individual or group over time[40]

The dynamics of the exchange of knowledge should sustain its use and growth through continuous creative development.

Designers, as part of the contributors, should see their role as meta-designers and empower users to be active designers rather than passive consumers.

In the past, system design methodologies focused on creating complex information systems as *complete* and closed-off systems through the efforts of a small group of people. The current adapted SER model, on the other hand, advocates for building *seeds* that can be continually developed and improved through the contributions of a large number of people over time, rather than trying to create a fully finished and self-contained system. This large number of people includes external, outside world users, that through continuous feedback should impact and redesign such systems.

2.5.1. SEED

A seed is a starting point for a collection of knowledge, problem specific, that is intended to grow and adapt as it is used. It is created by contributors and future users to be as comprehensive and actionable as possible, but it is impossible for any information repository to be fully complete due to the inherent nature of knowledge being both *situated and tacit*[41], as well as the constantly changing nature of the environment in which the system operates.

40. Kelly, Robert. 2016. Creative Development: Transforming Education through Design Thinking, Innovation, and Invention. Brush Education.

41. Suchman, Lucy A. 1987. Plans and Situated Actions: The Problem of Human-Machine Communication. Cambridge University Press. p. 99

While there may be strict requirements for the thoroughness, accuracy, or specificity of the information in the seed, due to limitations and failures of capturing and expected accuracy motivated by fast-paced environments, the seed often motivates users to add new information to it.

2.5.2. EVOLUTIONARY GROWTH

During the evolutionary growth (EG) phase, the seed is used and expanded to tackle specific tasks or address problems in a decentralized manner, with centralized architects or system keepers. Contributors and users are directly or indirectly, asynchronous and synchronous involved in this phase, as the focus is on defining and solving problems. The participants directly involved in the problem are responsible for designing solutions. In this phase, the information repository serves two purposes: it provides resources for the current task or problem (information that has been gathered from previous use or research), and it collects the products of the work being done, as each actor adds new information to the seed. Users during this phase are primarily focused on solving a specific problem and generating information specific to that problem, rather than creating information that can be easily reused. The reuse capture of information comes in short, iterative cycles, which should also be part of this phase and inform

the network. EG is operationalized and further amplified by divergent and convergent ideation which "enables the invention of completely new entities across a variety of fields".[42] As a result, the information added during this phase may not be well integrated with the rest of the seed as it generates unforeseen results, with an exponential value that should impact the system end-to-end, generating unforeseen branching needs of exploration and unforeseen contributors specialties to be included.

2.5.3. RESEEDING

"Reseeding is the process of deliberately and centrally organizing, formalizing, and generalizing the information, and artifacts created during the evolutionary growth phase".[43] It involves not only taking the information, and artifacts, but also individuals, teams, or groups of actors that emerged during the decentralized evolution of the seed and restructuring them in a way that makes them more organized, standardized, and applicable to a wider range of situations or environments.

The purpose of reseeding is to create moments for recalibration in the knowledge repository that is easy to navigate and allows for the reuse, reinjection, and expansion of useful information and also redesign possible collaboration structures or team optimizations. While contributors play a crucial role in making system and information space modifications, user participation is

42. Kelly, Robert. 2016. Creative Development: Transforming Education through Design Thinking, Innovation, and Invention. Brush Education. p. 58
43. Shipman, Frank M., and Raymond McCall. 1994. "Supporting Knowledge-Base Evolution with Incremental Formalization." In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 285–91. CHI '94. New York, NY, USA: Association for Computing Machinery.

also necessary because only they can determine what information is useful and what structures will support their work practices. This feedback systemic gesture is continuous. Reseeding also becomes necessary when the evolutionary growth of the seed becomes hindered or stagnant or produces far too complex results that tend to move too far away from desired solutions or resolutions and might cause silos in such environments. It provides an opportunity to evaluate the information generated during specific projects and activities and decide what should be included in a new seed to support future cycles of evolutionary growth and reseeding.

These continuous and evolving cycles of feedback loops to seeding, with the multidisciplinary and external audience (real world) reach, are therefore fundamental traits of an *open system* that performs internal and external of organizational boundaries into real-world and end-users.[44]

2.6. DESIGN TIME VS USE TIME

There are two main stages in the design process: design time and use time (as shown in Figure 5). During *design time*, system contributors (with or without user or end-user input) create guidelines, tools, and environments. In traditional design approaches, they create complete systems based on their own assumptions and expectations. However, during *use time*, users interact with the system and may have different needs, goals, and

44. Wu, Jen-Her, Yung-Cheng Chen, and Li-Min Lin. 2007. "Empirical Evaluation of the Revised End User Computing Acceptance Model." Computers in Human Behavior 23 (1): 162–74.

One fundamental challenge for the design of the interactive systems of the future is to invent and design environments and cultures in which humans can express themselves and engage in personally meaningful activities.[47]

situational contexts that were not anticipated during the design process. To allow for flexibility and adaptability during use time, it is necessary to leave some room for modification and customization based on the user's actual experiences and needs in their own environment and creative process. To accommodate unexpected discoveries at use time, systems need to be *underdesigned* at *design time*, while directly experiencing their own usage in the context of practical use cases. In fact, this attribute of underdesign is a requirement for enabling a fast-paced evolution of adjacent development areas with larger pieces of information. The notion of *underdesign*,[45] in this context, does not imply a decrease in workload or fewer requirements for the design team; rather, it is significantly distinct from the process of constructing closed or complete systems. The primary challenge of underdesign lies in the development of not solutions, but rather environments that enable the "owners of problems"[46] to create their own solutions at the use time, this is further amplified by the *owners of goals*, the end users, which are on a lower level of abstraction when it comes to *use time*. This fundamental gesture of creating spaces rather than solutions, resolutions rather than conclusions, is paramount to catalyze a sense of ownership, and from here a sense of power and consequence of decision-making or creative thinking for each system contributor/user.

45. Brand, Stewart. 1995. How Buildings Learn: What Happens After They're Built a Book by Stewart Brand.
46. Fischer, Gerhard. 1994. "Putting the Owners of Problems in Charge with Domain-Oriented Design Environments"
47. Arias, Ernesto, Hal Eden, Gerhard Fischer, Andrew Gorman, and Eric Scharff. 2000. "Transcending the Individual Human Mind—Creating Shared Understanding through Collaborative Design." ACM Transactions on Computer-Human Interaction 7 (1): 84–113.

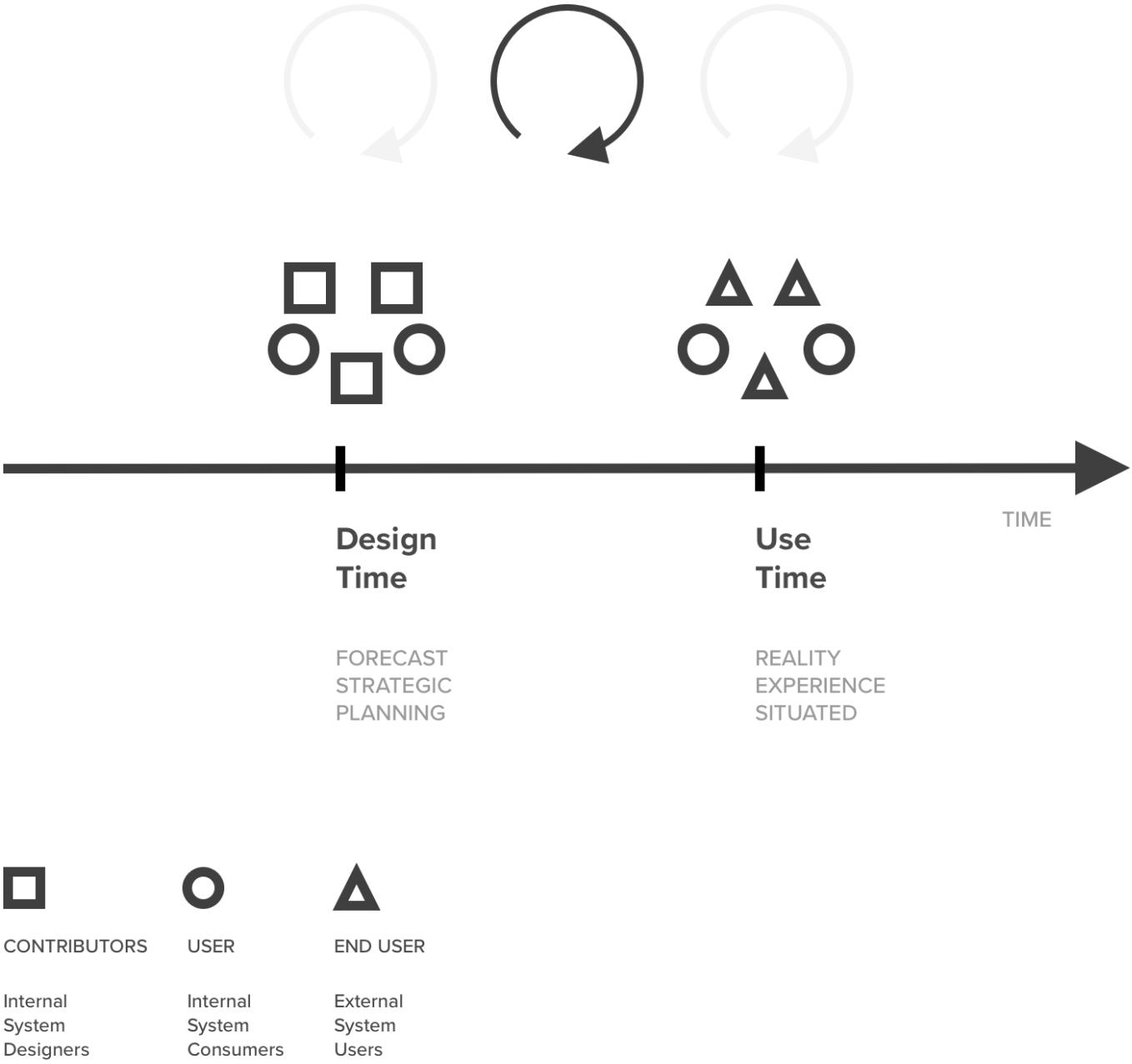


Figure 7.

Design Time and Use Time in development and real-world environments

Providing a context and background, documenting in synchronous and asynchronous channels enables the user to interpret and resolve situated cases that arise during development phases.

Underdesign is, therefore, a defining activity for meta-design, with the purpose of creating design spaces for other people.

In this design process, the user is not limited to a binary choice between being a consumer or a

Form ever follows function[48]

The very opposite concept is Winston Churchill's "We shape our buildings, and afterwards our buildings shape us." (...) Form-follows-function misled a century of architects into believing that they could really anticipate function. Churchill's ringing and-then-they-shape-us truncated the fuller cycle of reality. First we shape our buildings, then they shape us, then we shape them again—ad infinitum. Function reforms form, perpetually.[49]

designer, but rather that there is a continuum ranging from passive to active, consumer to meta-designer, consumer to the user. Furthermore, it is expected that the same individual may assume all roles, depending on the context, problem to be solved, or expectation of a job to be done. Thus, it can be concluded that designer/consumer/user is not an attribute of a person, but rather roles assumed in specific contexts, that will ultimately bring value to the individual that assumes such roles, and the system that will continuously evolve from such dynamic permutations.

Taking the analogy, from architecture to the present context, I argue that this continuum feedback, is the living blood of such open systems, that first requires that the contributors and users to be flexible or hybrid in active or passive roles so that, just like the artifacts that are created through such systemic networks, they are open to evolution, even revolution, when the context or reality is of such need. Furthermore, this flexibility will itself create new realities and contexts, being that this nonlinear sequence is of defining the importance of this duality of *design time* and *use time*.

2.6.1. TEAM(S) BEHAVIORAL HEURISTIC MODEL

Towards a Fractal Creative Process.

Moving at a lower level of abstraction space, from the dynamics of design time and use time, towards the dynamics

48. "Written in 1896 by Louis Sullivan, the Chicago highrise designer, it was the founding idea of Modernist architecture" in Brand, Stewart. 1995. "How Buildings Learn: What Happens After They're Built", p. 12

49. Brand, Stewart. 1995. How Buildings Learn: What Happens After They're Built a Book by Stewart Brand. p. 13

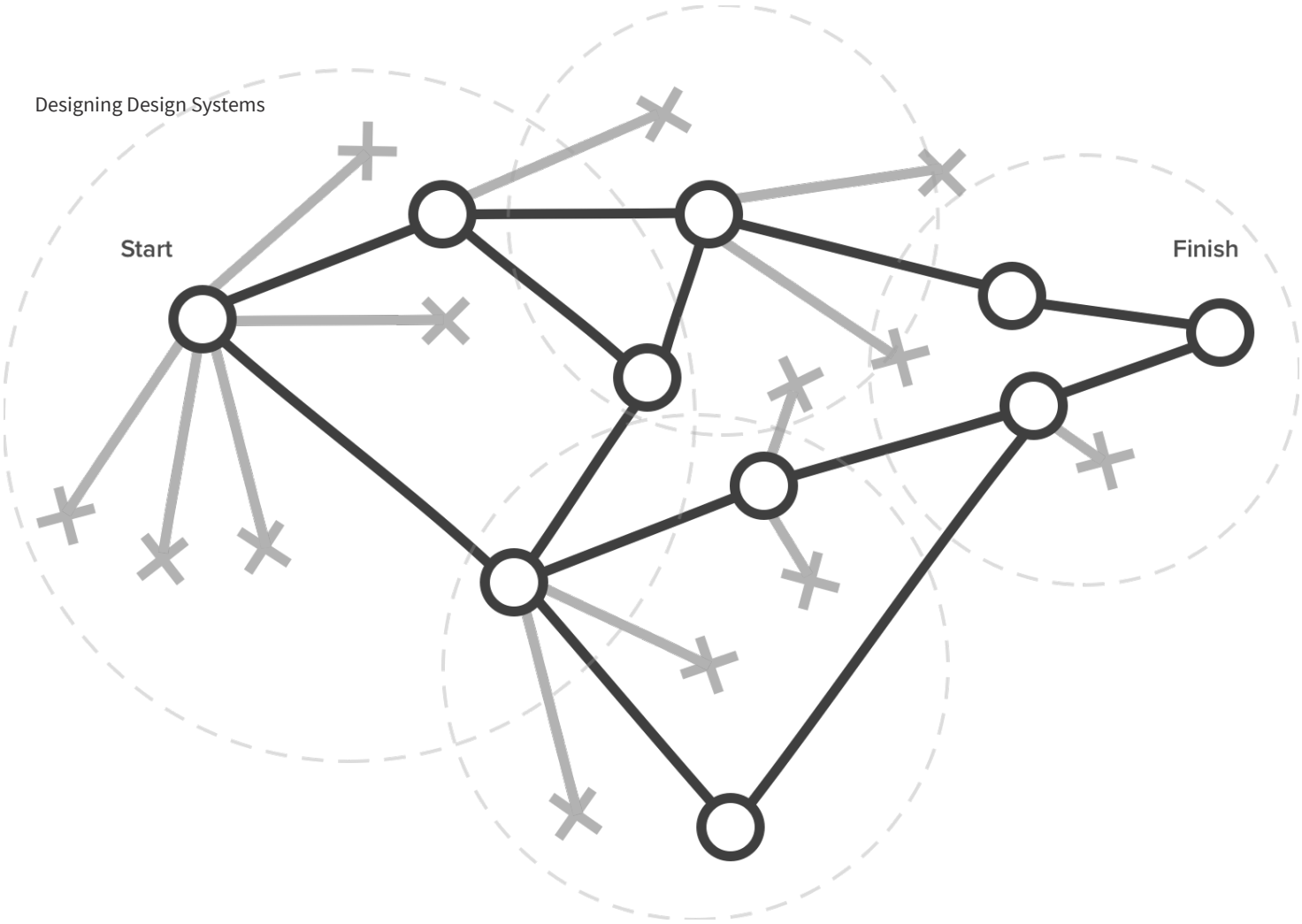


Figure 8.

Behavioral Heuristic Model

of each individual or group of individuals, each dotted circumference can represent one team/unit of individuals with a specific skill set or specialization. The intersections represent not only a linear sequence or hand-off of artifacts or knowledge, but also of symmetry of information and shared context, that guarantees an informed progression with resources to recursive patterns.

This progression can be linear, but also can be non-linear and nonsequential at all. In fact, at some point of expertise, it can happen simultaneously in different spaces of development that form and compose Figure 8.

Progress is made by creating branches of exploration, forming a tree structure. Some of these branches will be a dead-end, and others will open up new branches to pursue further, deploying a self-sustaining and iterative pattern

that repeats infinitely on every scale, small and large. No matter how deep you zoom in or out, the same pattern emerges.

Great work arises (e.g. Experience Design) related not only to the fact of knowing which branches to kill, and which to zoom in on. It's also about knowing when to zoom out.

While this conceptualization addresses mainly a progression or sequence of events or touchpoints between specialties of contributors required to produce information or artifacts through these systems, it's important to mention that the notion of contributor/team(s) or functional units that are implicit in each circle represented in Figure 8, is also continuously changing and adapting itself to different contexts and realities that emerge from each interaction and iteration as a product of each branch exploration.

So, this serves to reaffirm that, there is not a complete progression mapping before the exploration starts, making it necessary to propagate clearly a creative direction, continuously and redundantly through the progression into the *unknown*. This progression is assured by a foundational framework that upholds and guides by the creative vision principles and heuristics.

3. INTRODUCTION TO SUB DESIGN SYSTEMS

3.1. WHAT IS A HUMAN COMPUTER INTERACTION SYSTEM (HCIS)

A HCIS is a cross-cultural and cross-discipline framework for design that upholds:

- **Consistency**: Processual clarity, clear guidance, governance models
- **Trust**: Confidence and focus on the right problems to solve for
- **Relationships**: It's all about the people, a system for humans.

A HCIS is part of a wider global communication system where all foundational principles, processes, and artifacts, related to a single entity or brand, or groups of entities or brands, should be made available, with transparency, for self-service consumption.

3.2. A SINGLE SOURCE OF TRUTH (SSOT).

The term "Single Source of Truth" (SSoT) has been widely used in the field of information management and software development. While it is challenging to pinpoint the exact origin of the term, it has gained prominence in various industries and contexts. One example is referenced in the paper[50] by Candy Pang & Duane Szafron that describes how to use a SSoT service to eliminate data replication in environments of Service Oriented Architecture (SOA).

A SSoT, can be described as a centralized repository of information and assets related to this specific sub system and at

50. Pang, Candy, and Duane Szafron. 2014. "Single Source of Truth (SSOT) for Service Oriented Architecture (SOA)." In Service-Oriented Computing, edited by Xavier Franch, Aditya K. Ghose, Grace A. Lewis, and Sami Bhiri, 575–89. Lecture Notes in Computer Science. Berlin, Heidelberg: Springer.

Knowledge bases to support design should include not only knowledge about the design process but also knowledge about the artifacts of that process—parts used in designing artifacts, subassemblies previously created by other design efforts, and rationale for previous design decisions.[51]

a macro level, the Global Design System. This source of truth serves as a directive source of information for all contributors and users, including designers, developers, and other stakeholders. It contains the deliverables and information about the design system's components as well as usage guidelines and other relevant information. By having a SSoT, organizations can ensure that everyone is using the same information, at its latest state, and that the design systems remain consistent and up-to-date. This, in turn, helps to support efficient and effective design and development processes, and helps to minimize the risk of errors and inconsistencies in the design.

Branching from a higher-level abstraction, a global conceptualization, a HCIS is a direct response to an interaction attribute and requirement of this global communication system. Furthermore, this branch of development deals directly with Human-computer interaction (HCI), User Experience Design (UX), User Interface Design (UI), Interaction Design (IxD), and more.

Let's look at this definition from two perspectives: The contributor and the user.

3.3. A HCIS FOR CONTRIBUTORS

A HCIS is a set of guidelines that helps manage user experience design efforts on a large scale by reducing duplication and

51. Fischer, Gerhard, Jonathan Grudin, Andreas Lemke, Raymond McCall, Jonathan Ostwald, Brent Reeves, and Frank Shipman. 1992. "Supporting Indirect Collaborative Design With Integrated Knowledge-Based Design Environments." Human-Computer Interaction 7 (3): 281–314.

establishing a shared vocabulary and visual consistency across various mediums, pages, and channels. It is a processual framework and general construction and communication tool that enables a design-driven workflow to give an optimal answer toward an efficient production process.

A HCIS upholds design and technology deliverables, consistency, trust between peers, and meaningful and collaborative relationships to propagate information and artifacts through a network of humans. It's defined by rules and processes to be applied to recurring UI/UX patterns, Constraints (design kit(s) library(ies)), and Principles of Design (Guidelines) for a fast-paced dynamic in problem-solving decisions. Principles should provide guidance to generate new visual elements and interfaces that can create a simplified and joyful render of detailed and complex information. Ultimately, better-assisting users through their journey through digital spaces and experiences.

The elaboration of such foundational principles to this interactive design language branch is set from a root global set of directives contained in the global system, so the actors directly involved in the creation of these branched sets of principles are the owners of these decisions.

Now, let's expand on what we mean by consistency, trust, and relationships.

Consistency is a fundamental requirement where multiple

Governance for a design system comprises the processes that control decision-making, contribution, enhancements and workflows for the design system. It's the control center of the design system, including agreement on roles, responsibilities and process for its evolution.[54]

contributors use and produce the available resources distributed through these systems. It's therefore a requirement not only to the methodologies involved in the construction of such systems but also ultimately in the product that is created through these systems. As the structure of such systems is dynamic, so are the processes and guidance mechanisms to achieve the results. Consistency can often be seen as homogeneity and thus as some constraint or limitation to creativity. Therefore it's important to state that we should not look at it as uniformity but as a context-aware quality that makes sure a particular set of steps needed for decision-making are taken in a transversal application. A unified strategy to solve any problem.

One fundamental initiative towards consistency is to unify and synchronize the designer and engineer workflows by introducing e.g. versioning tools and methodologies to the designer workflow like 'Plant'[52] or 'Abstract'.[53] If there's no symmetry and alignment between these workstreams, it's necessary to redesign such workflows. Bringing them closer.

Trust is a condition on which good relationships are built. When two professionals connect through such systems, a logical sequence and expectation of engagement is predefined and set the foundation for shared connection points they

52. "Version Control App and Sketch Plugin for Designers" 2023
53. "Version Control for Sketch | Abstract" 2023
54. "Governance by Design: Building Successful Design Systems" 2020

need to better understand each other, like a shared language and goals. These professionals can be from the same field of expertise or from different disciplines. Consistency surfaces from this notion of shared language, a Design Language, which we'll understand in more detail ahead in this text.

Collaboration is also a key requirement to build such systems, to achieve optimal collaboration streams, governance models should be built and maintained.

It's about taming complexity.

A HCIS is a "collection of reusable components, guided by clear standards, that can be assembled together to build any number of applications."[55]

With complexity comes an increased need to bring order to chaos. While creativity thrives from some chaos, in software development this modular and systemic creative and productive gesture will benefit a business with a competitive advantage, by applying an orchestrated rationale of ideation and development at scale. This maturity and scale come from optimized processes. Innovation is possible because complexity is tamed, and teams can focus on aspects that are measured and quantified in ways that really make a difference and are identifiable in networks of ideation and implementation. The other way around is a fact where teams lose time and focus to reinvent the wheel, in most cases, the wrong *wheel*. This metaphor illustrates a use case where not only is the focus on the right

55. Fanguy, Will. n.d. "A Comprehensive Guide to Design Systems | Inside Design Blog." Accessed November 15, 2022.

problem to solve off, but the time wasted to solve the wrong problem is preventing the real challenge to solve, to emerge, and therefore being solved.

This system is ever-evolving. I propose a highly emotional engagement that is needed from the contributors involved in creating, maintaining, and evolving such initiatives. Once each of these contributors are acting as *owners of problems,*[56] a sense of joyfulness should be acquired by the sense of optimal collaboration and of a job well done, with optimal design time. One of the most challenging problems to solve is this networked empathy that should be generated and propagated by the contributors and ultimately by the users of these systems.

It's fundamental to communicate what has been achieved, receive feedback from users and contributors, and re-inject into it. Learn from this culture of feedback and continuous iteration rather than perfection.

56. Fischer, Gerhard. 1994. "Putting the Owners of Problems in Charge with Domain-Oriented Design Environments,"

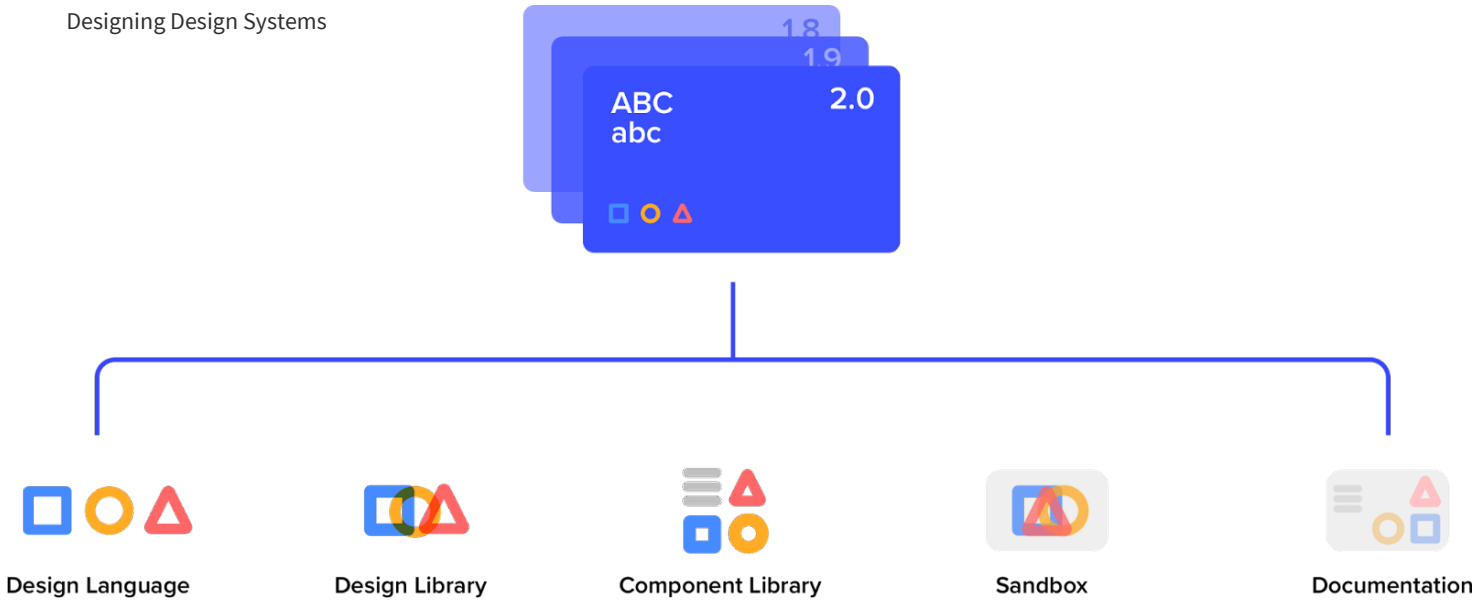


Figure 9.

HCIS Simplified Structure

3.4. A HCIS FOR USERS

A HCIS contains and distributes deliverables such as:

- **Design Language(s)**: Workflows that include the foundations of identity of a brand, that are developed in other branches of exploration that originate design primitives (e.g., fonts, spacing, color), Communication & Graphic Design, Illustration, Tone of Voice. The origin point where Design Principles and Guidelines are being built and distributed will create the first deliverables at an *atomic*[57] level.
- **Design Library(ies)**: A design library is a collection of assets, guidelines, and standards that describe a HCIS. These assets are shared between design teams and available in the software that is used to build UX, UI, and IxD.
- **Code Library(ies)**: A component library is a collection of components, organized in a meaningful manner, and often providing some way to browse and preview those components and their associated assets and code packages.
- **Documentation & Culture Hub**: A cluster of information and communication about the system and its status and iterations. Any mechanism that enables the possibility of sending and gathering feedback, information, and all relevant information for the

57. "Atomic Design | Atomic Design by Brad Frost" 2022

consumers and community in general.

- **A Governance and guidance model**: Management framework where all project decisions are made. Therefore, the role of this governance model is to provide a decision-making framework that is logical, robust, and repeatable. Enhancing trust & shared ownership through clear guidance.
- **Design & Code Sandbox**: Environments for design and development testing without affecting the system environment, e.g. perform and apply research results to possible feature iteration in such environments

Some of these deliverables are tangible, and some are not. We can reason as tangible for the artifacts or design elements and components and not tangible for the process, trust, or shared ownership that is involved in the chain of production of such events. One might say, the culture and mindset that are intrinsically associated with such transactional activities. These transactions define in a primordial way the quality and livelihood of such systemic fabrics.

A HCIS is strategically positioned inside the network of development of the larger communication system, as seen depicted in Figure 10.

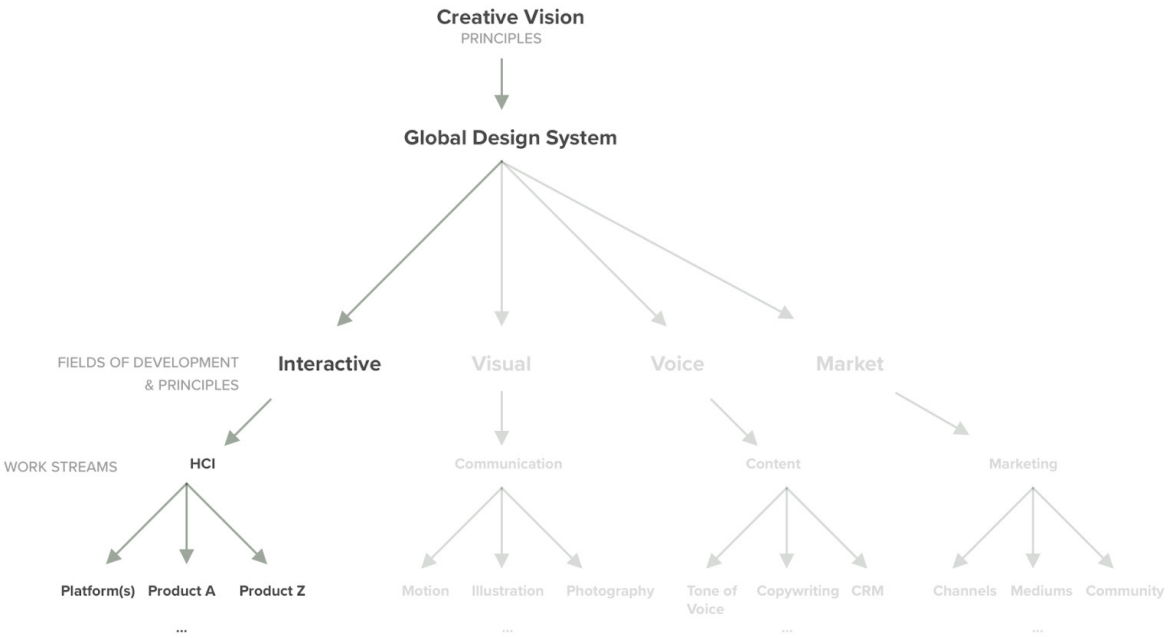


Figure 10.

Human Computer Interaction Sub-System

3.5. METHODOLOGY

Figure 11, below, represents in a very synthetic way the progression of work inside this workstream. A central repository of information, the single source of truth (SSoT) often materialized in a web platform, is versioned as new information is being added to it from different streams of work. This SSoT is the reference and provides guidance for consumers and users of this system, to use this information to build their own dependencies, for design and code libraries.

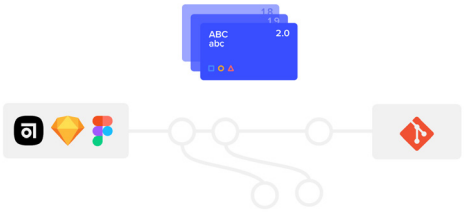


Figure 11.

A high-level view of Design and Code Versioning

At a lower level of this workflow we can observe the following simplified steps. The Designer creates a branch in its editing tool, with the ID of a task on Sprint to start designing. Once reviewed and approved by all peers and direct stakeholders this same process is performed by the Developer. Once a *pull request*[58] for the artifact is merged from the development side the same will be merged in the design documentation ensuring information symmetry. This information and assets are now available in the ecosystem to be consumed.

Some of the benefits of using such methodologies are:

58. Pull requests let you tell others about changes you've pushed to a branch in a repository on GitHub. Once a pull request is opened, you can discuss and review the potential changes with collaborators and add follow-up commits before your changes are merged into the base branch. "About Pull Requests" 2023

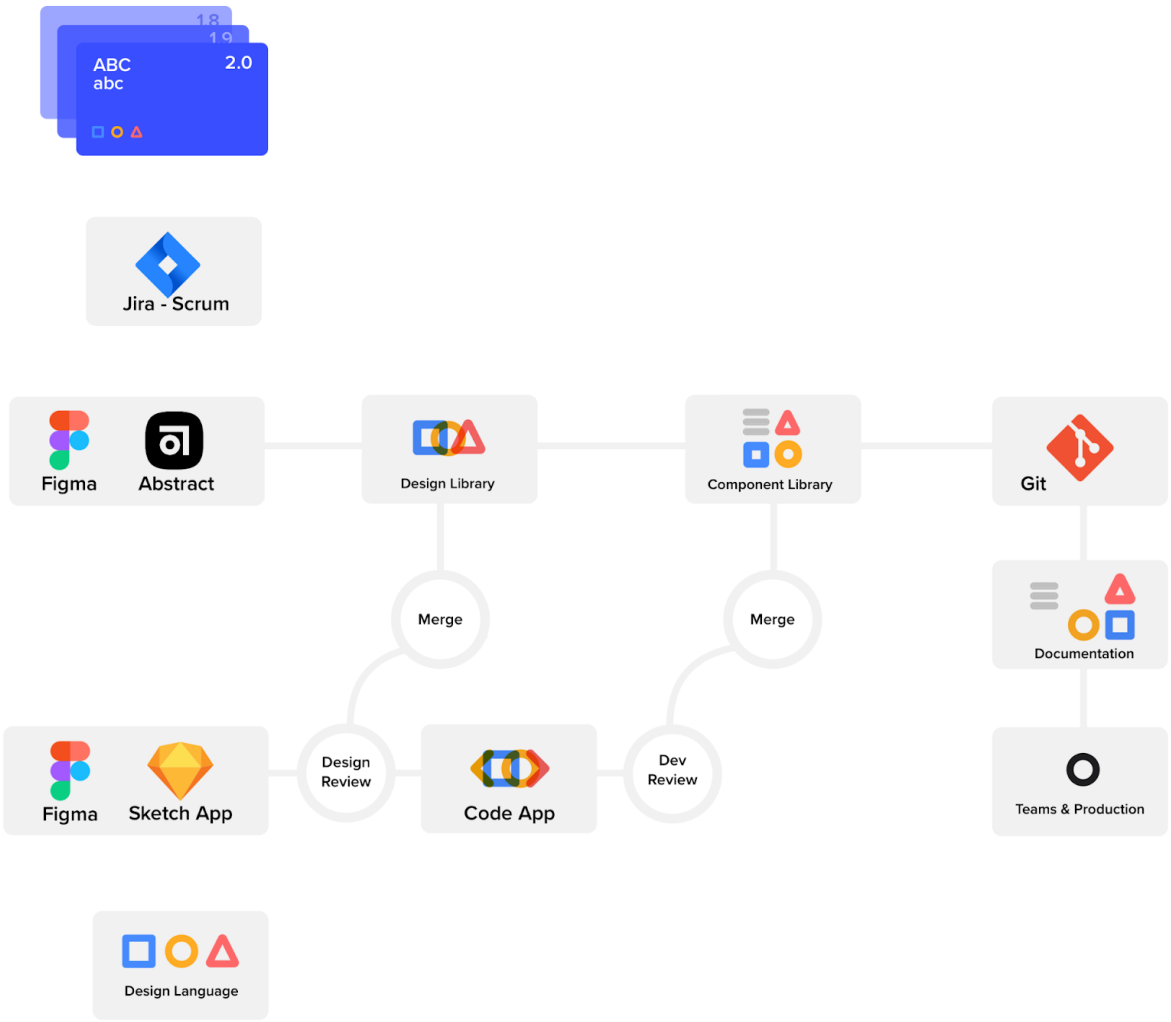


Figure 12.

Low-level view of Design and Code Versioning

Shared understanding and ownership: When designing a system collaboratively, all team members have the opportunity to understand and contribute to the design principles, guidelines, and components. This leads to a shared sense of ownership and responsibility, which can improve alignment and buy-in for the project as to a sharpened sense of quality assurance in each hand-off stage. When everyone is working towards the same goal and using the same set of rules, it can reduce misunderstandings and ensure

that the workflow and artifacts are consistent and cohesive.

Optimal communication flow between Design and Engineering teams: Communication is critical for successful creation and implementation methodologies. It's fundamental that there is parity in the understanding of each other's needs and priorities in order to define clear intersections in these different disciplines. This can help to mitigate and resolve any potential issues that may arise, by setting clear expectations and defining foundational agreements, therefore leading to a more streamlined and efficient design and development process. As a result, the final product will have improved overall quality, and the teams will be able to better meet the goals set for the project.

Culture and rituals make the work better: Establishing good practices can help drive adoption and improve the quality of the work and the quality of the processes involved. Time for serendipity and the emergence of the unexpected, even errors, are apparently banal but much required factors of healthy teams and individuals, therefore the work produced. Activities can involve informal gatherings, coffee breaks, regular design reviews, user testing sessions, and any kind of spontaneous collaboration models between team members to continually refine and improve the system.

Reduced design and development costs: By applying modularity and standardizing the design and development processes, it is possible to reduce the time and resources required to maintain or create new designs and features. This can result in lower costs and a more efficient workflow. By using a shared set of design components and guidelines, designers can focus on the real problems to be solved and on creating unique and innovative solutions just by combining existing building blocks, rather than reinventing the wheel for every project.

Improved time-to-market: When everyone is using the same set of design components and guidelines, it reduces the time required for design and development, as well as minimizes misunderstandings and rework. While in the market, the product or service gets further validation, or not, from end-users. This is critical for reinjection of value based on this feedback, that restarts the flow of design and development based on this new data.

Continuous improvement based on data: System contributors should set and use Key Performance Indicators (KPIs)[59], analytics and user testing results to make informed decisions about changes to the system and how to plan and apply low-level detail to the continuous roadmap to improve over time. This can lead to a better user experience and a more effective system that ultimately meets the needs of end-users.

59. Ante, G., F. Facchini, G. Mossa, and S. Digiesi. 2018. "Developing a Key Performance Indicators Tree for Lean and Smart Production Systems." IFAC-PapersOnLine, 16th IFAC Symposium on Information Control Problems in Manufacturing INCOM 2018, 51 (11): 13–18.

Build consistent, branded experiences across all regions and touch-points: The use of consistent and cohesive design guidelines can significantly impact how a brand is perceived, both internally and externally. Internally, it helps to ensure that all teams, including those that may not have direct access to the context of a particular project or product, are able to contribute to a consistent and cohesive brand experience. By having a shared understanding of components and guidelines, these teams can be more confident in their work and help to reinforce the brand's messaging and identity.

Externally, the impact of consistent and cohesive guidelines is even more pronounced. End-users are often presented with various touchpoints, such as websites, products, advertisements, and social media, that represent the brand. If these touchpoints are not consistent in their appearance and messaging, it can create confusion and negatively impact the perception of the brand. However, if a consistent and cohesive system is in place, end-users are able to quickly recognize and understand the brand, which contributes to a meaningful user experience and helps build trust with the brand.

Unified workflow: Mentioned before, this notion of parity, can result in improved collaboration and efficiency, as well as a more streamlined and cohesive work environment. When everyone is

For best purposes, there should be a feeling of informality. Joviality, the use of first names, joking, relaxed kidding are, I think, of the essence—not in themselves, but because they encourage a willingness to be involved in the folly of creativeness.[61]

working with the same set of rules, components and guidelines, it can reduce misunderstandings and improve communication, leading to a smoother and more efficient design and development process. Sharing a unified language.

Focus on the right challenges to solve: Too often, designers and organizations get fixated on a solution before fully understanding the problem they are trying to solve. This can lead to misguided efforts and ineffective solutions.

As a macro analogy lets take Levine, who suggests[60] that instead of falling in love with a solution, designers should fall in love with the problem they are trying to solve. By deeply understanding the problem and the context surrounding it, designers are better equipped to find the right solution. This requires a deep dive into the problem space and a willingness to experiment and iterate until the right solution is found.

When a contributor receives a design for new functionality in any channel, a clear mapping of the components and processual model is seen to their implementation in code. So 90% of the page can be assembled from the pre-assembled building blocks.

This common ground means that developers and designers can collaborate and share knowledge quickly, sharing a unified language.

Joyful contributions mean more efficiency, quality, and meaningful design and use times.

60. Levine, Uri. 2023. Fall in Love with the Problem, Not the Solution: A Handbook for Entrepreneurs. BenBella Books.
61. "Isaac Asimov Asks, 'How Do People Get New Ideas?' | MIT Technology Review." n.d. Accessed February 7, 2023.

3.6. FROM IDEA TO PRODUCTION

3.6.1. HCIS USER FLOW

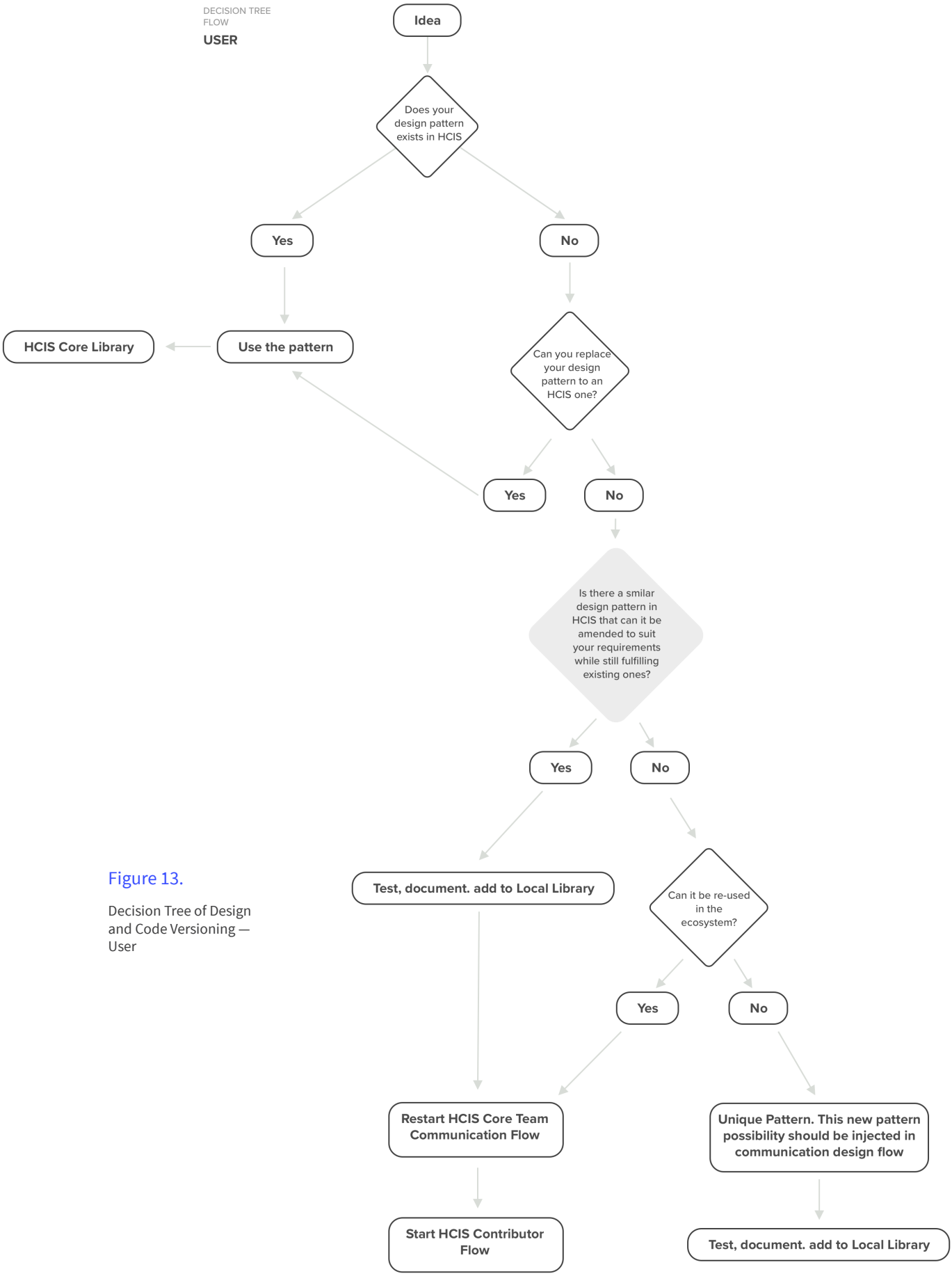


Figure 13.

Decision Tree of Design and Code Versioning — User

3.6.2. HCIS CONTRIBUTOR FLOW

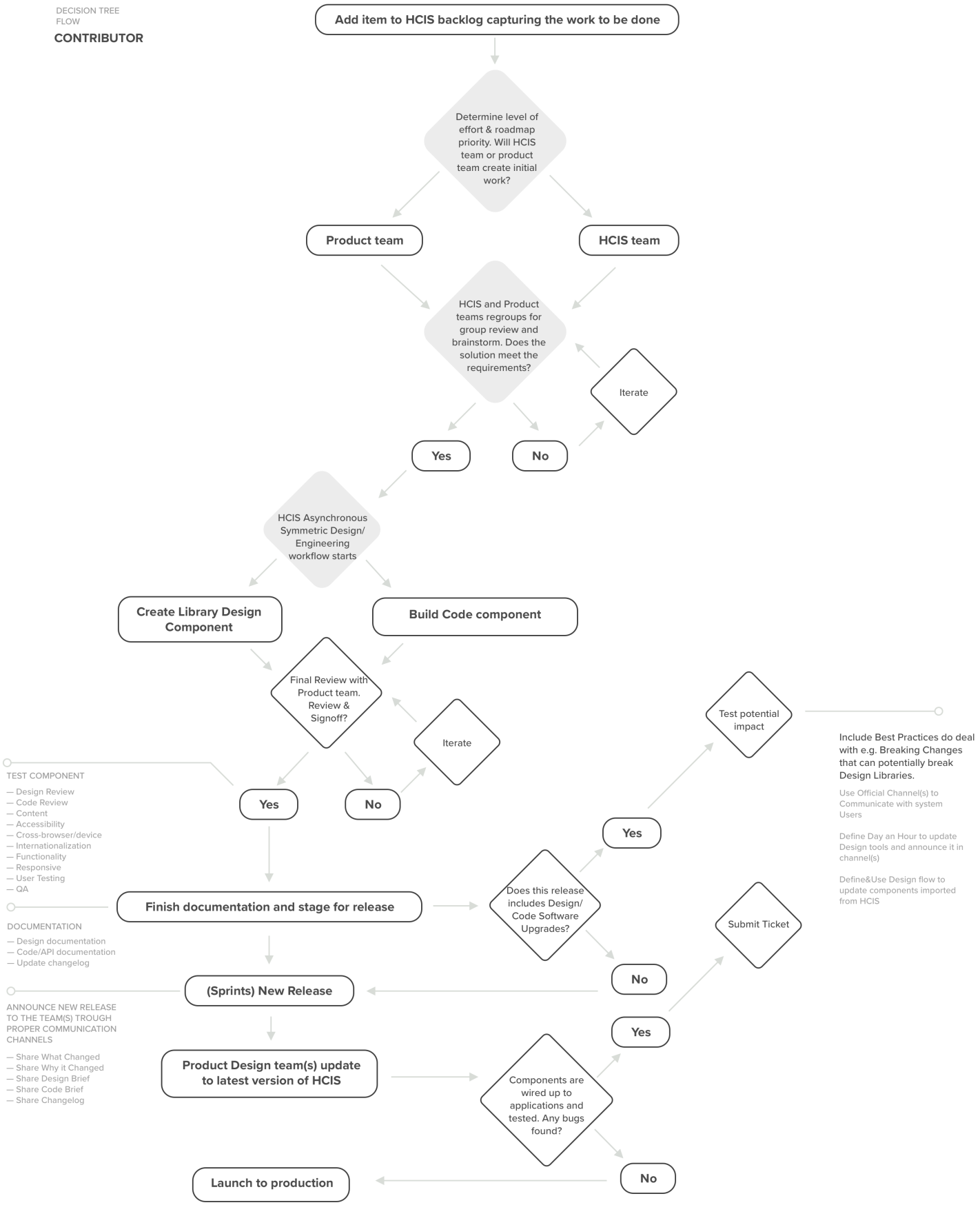


Figure 14.

Decision Tree of Design and Code Versioning — Contributor

3.7. PROBLEMS THAT A HCIS PROPOSES TO SOLVE

Problems that are being solved by the use of such systems include some of the topics that will be disclosed below. These ‘problems' are common pitfalls of digital product development, and serve the purpose to contextualize the use of such systems for User Experience, and in the context of the Interactive branch of exploration for a Global Design System, discussed in this paper.

3.7.1. THE DUPLICATED EFFORT PROBLEM

Due to the lack of information symmetry, time is wasted re-solving the same problems. Time equals money x times each professional involved. Applying effort to solve duplicate problems means that you are not solving the right challenges x times different team members x times different teams. Let's take this example: a designer, engineer, and QA engineer will design, build and test a component. If each of these people costs $120/hr, and it takes one two-week sprint[62] cycle to deliver a component, let's say a button. This button costs upwards of $28,800 to create. So, 3 people at $120/hr x times 80 hrs equals $28,800. If we take this value of $28,800 x times 20 teams equal $576.000 for a button.

3.7.2. THE PROCESS PROBLEM

Developers become blocked as designs are iterated and changed, as a consequence product

62. A sprint is a short, time-boxed period when a scrum team works to complete a set amount of work. "Scrum Sprints: Everything You Need to Know | Atlassian" 2023

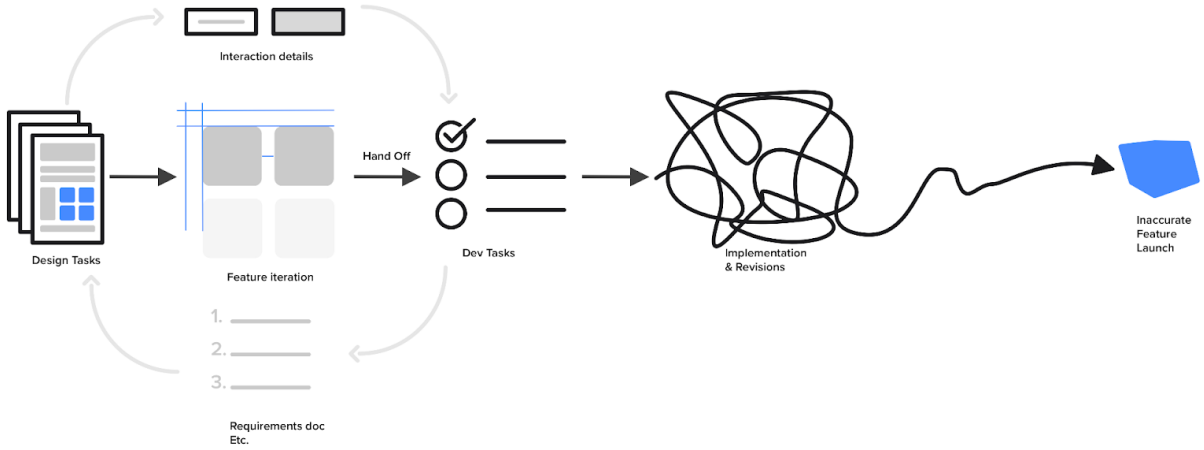


Figure 15.

Processual Entropy

design becomes inconsistent across different teams or over time, and product interface and experience maintenance becomes unsustainable.

Because there is no single source of truth, a breakdown of shared context between disciplines results in poor product decisions. This is a core issue that is addressed by the very aggregative and convergent nature of a HCIS into a central hub for documentation.

3.7.3. THE HANDOFF PROBLEM

The traditional waterfall[63] approach, in itself, represents a challenge to be overcome. As something changes in this process, the waterfall comes with heaps of design and technical debt. Most organizations treat websites as a collection of pages. Pages provide a holistic view of the design problem — what content are we displaying, what is its purpose, how are we going to display this content and how is the user going to interact with it.

3.7.4. MULTIPLE SOURCES OF TRUTH

Without a network of shared knowledge, designers and developers find assets stored in different locations, with no clear way to keep track of these assets' evolution or versioning history, making it very easy to duplicate and/or use obsolete versions of the same assets.

Taking this uncertainty to development flow and production would repeat and amplify work duplication for sometimes

63. The Waterfall methodology — also known as the Waterfall model — is a sequential development process that flows like a waterfall through all phases of a project (analysis, design, development, and testing, for example), with each phase completely wrapping up before the next phase begins." Adobe Communications Team 2023

deprecated assets and flows, therefore, increasing inconsistency and a silo behavior.

3.7.5. BENCHMARKS

As references in the market, we can approach the following examples as the more advanced and with more reach for users on this subject.

As a first benchmark we have Human Interface Guidelines by Apple, where everyone can "get in-depth information and Ul resources for designing great apps that integrate seamlessly with Apple platforms. Human Interface Guidelines provides components and tools to help you work more efficiently, and to make your applications more cohesive."[64]

Secondly, is Material by Google. "Material Design is an adaptable system of guidelines, components, and tools that support the best practices of user interface design. Backed by open-source code, Material Design streamlines collaboration between designers and developers, and helps teams quickly build beautiful products."[65]

Thirdly, "Carbon is IBM's open source design system for products and digital experiences. With the IBM Design Language as its foundation, the system consists of working code, design tools and resources, human interface guidelines, and a vibrant community of contributors."[66]

There are many more initiatives, from which these three options were selected. The reason is the complexity and similarities with holistic systems thinking,

64. Apple. n.d. "Human Interface Guidelines - Human Interface Guidelines - Design - Apple Developer." Accessed October 20, 2022.
65. Google. n.d. "Material Design." Material Design. Accessed October 20, 2022.
66. IBM. n.d. "Carbon Design System." Accessed October 20, 2022

4. ATOMIC DESIGN

The process of rapidly iterating and creating Minimum Viable Products[67] (MVPs) is not exclusive to software development but can be applied to the assembly of much larger and more complex products. A ship, a building, and a car are all composed of components, which can be manipulated and adapted to achieve flexibility, speed, and a balance between independence and collaboration.

In software or product development, diving into lower-level detail, we arrive at the elemental building blocks of what constitutes, for the most part, the tangible and visible matter of the deliverables, created and transacted in these systems.

The fundamental attributes, in the form of design primitives or design tokens, are the indivisible units that create the *atomic* unity and singularity that ultimately creates a unique identity and therefore a unique experience.

Introduced by Brad Frost, a well-known web designer, this concept and methodology is a systematic approach to designing interfaces by breaking them down into smaller, reusable components called atoms and building them up into more complex components.

Atomic design involves the simultaneous utilization of atoms, molecules, organisms, templates, and pages in order to create efficient interface HCISs. The elemental components are built and transacted through networks of contributors and users of such systems.

67. Dennehy, Denis, et al. 2019. "A Lean Start-up Approach for Developing Minimum Viable Products in an Established Company." Journal of Decision Systems 28 (3): 224–32.

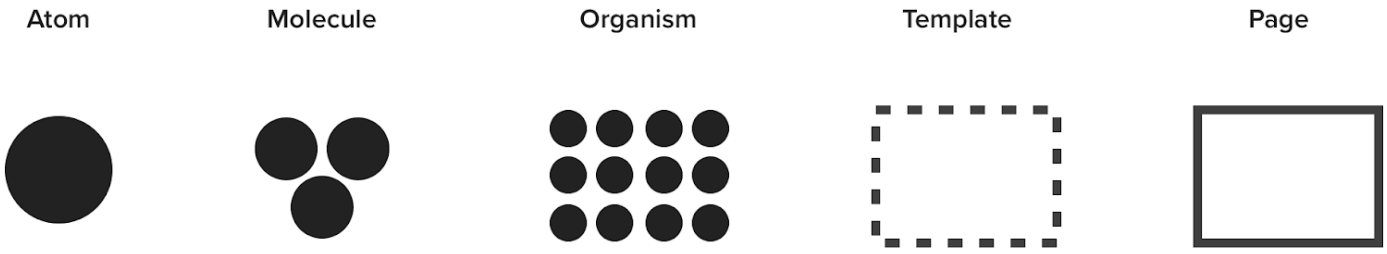


Figure 16.

Atomic Design[68] process

4.1. ATOMS

Atoms serve as the essential building blocks that constitute all user interfaces. These encompass basic HTML elements such as form labels, inputs, buttons, and others that cannot be further divided without losing their functionality. The smallest part of an atom is the design primitives like: color, space, and typography. Atoms may contain more conceptual attributes, such as hue groupings, or motion.

4.2. MOLECULES

When atoms are combined together, we start scaling towards molecules. Molecules are groups of atoms bonded together and are the smallest fundamental units of a compound. These molecules, once assembled for different contexts and goals, take on their own properties and functional facets and serve as the backbone of HCISs. These types of components should be a simple combination of atoms and built for reuse, therefore modularity. A molecule should have two or three atoms combined. An example of molecules are a search bar (combining an input field, a button, and an icon) or a product card (combining an image, title, and price).

4.3. ORGANISMS

Molecules provide us with some smarter components, which are characterized by more complex attributes to build from, and we can now assemble them together to create organisms. Organisms are collections of molecules

68. Frost, Brad. 2016. Atomic Design. Pittsburgh, Pennsylvania: Brad Frost.

Atomic design is not a linear process, but rather a mental model to help us think of our user interfaces as both a cohesive whole and a collection of parts at the same time. Each of the five stages plays a key role in the hierarchy of our interface design systems.[69]

interlinked to form bigger, distinct parts of an interface or experience, with more advanced functional capabilities and multiple endpoints triggers possibilities.

Examples of organisms include main navigation bars, sidebars, or product grids. These smarter groups of molecules can be reused across multiple endpoints or pages.

4.4. TEMPLATES

Templates usually consist of combinations of organisms fitted together to create pages or any piece of software. This is where the construction begins to take shape and we may observe attributes like arrangement and composition manifest. Templates are explicit and offer clarity to all these rather abstract molecules and organisms, and how they relate to the environments in which they're being deployed. Templates can be seen as placeholders for the final content that emerges in the final stage of this proposed process. As an example, a blog template would define the layout of blog posts with placeholders for the header, content, and sidebar organisms.

4.5. PAGES

Pages are concrete instances of templates. Here, placeholder content is substituted with genuine exemplifying data to deliver a precise rendering of what a user will interact with, to achieve his goals. In this phase, business logic and product requirements are injected to make the environment fully functional from all fronts and goals. Pages are the utmost level

69. Frost, Brad. n.d. "Atomic Design | Atomic Design by Brad Frost." Accessed October 20, 2022

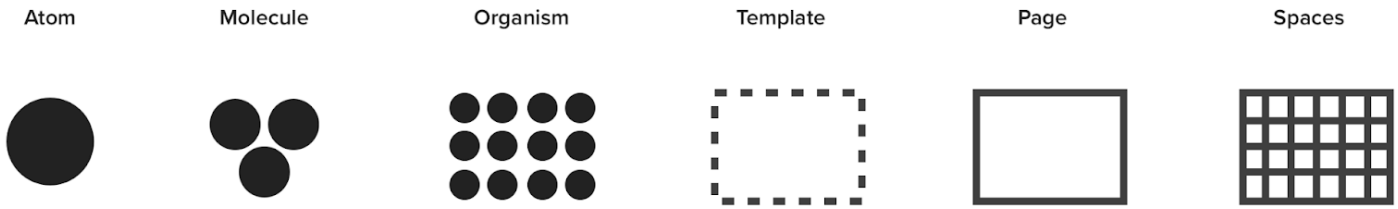


Figure 17.

Augmented Atomic process

of accuracy and because they're the most perceptible, it's normally where the majority of people in the process spend the majority of their energy and what most assessments rotate around.

This Page stage is critical as it's where a trial of the operation of the HCIS is made, or where assumptions made by research or instinct are validated or not. In fact, the final validation, from end-users should be accessed from this point forward. Examining everything in context permits the contributors and users of the systems to loop back to adjust atoms, molecules, organisms, and templates to confront the effectiveness and context of the decisions previously made and design and develop efforts to arrive at the particular stage.

4.6. SPACES

Spaces are collections of Pages, user flows, artifacts of information, and documentation. This proposal of an additional step in this process, to the existing framework, represents a larger-scale approach to solving exponential complexity involved in the development work of e.g. multiple platforms, and complex product suites with interdependencies.

With the inclusion of this macro view of groups of pages or logical user flows, individuals and teams have quick access to clusters of information that are easier to identify and provide foundational user experience documentation for further development and refinement. All other component-level dependencies are maintained

throughout multiple endpoints and teams.

At an operational level, design teams build their own repositories of information — Local Libraries — from the Core Libraries, developed by contributors of the HCIS.

This new step proposition in such methodology deals with the scaling and expansion of components and macro information mapping and distribution. This step involves taking the design system beyond the initial set of templates and pages and expanding it to include additional information like flows of components and pages, flows of logic and experience, variations, and iterations to meet the evolving needs of the product or service for all the teams involved. The focus is on ensuring consistency, efficiency, and modularity as the system grows and evolves by providing clear guidance to spaces of meaningful context.

Active repositories, with centralized information and documentation and open, synchronous and asynchronous communication channels are essential to such an approach. Spaces are created on demand to open and share context from A to Z.

Spaces are a direct contribution of the present work, as it emerges from a necessity and consequence of the Global Design System framework approach discussed in this body of work.

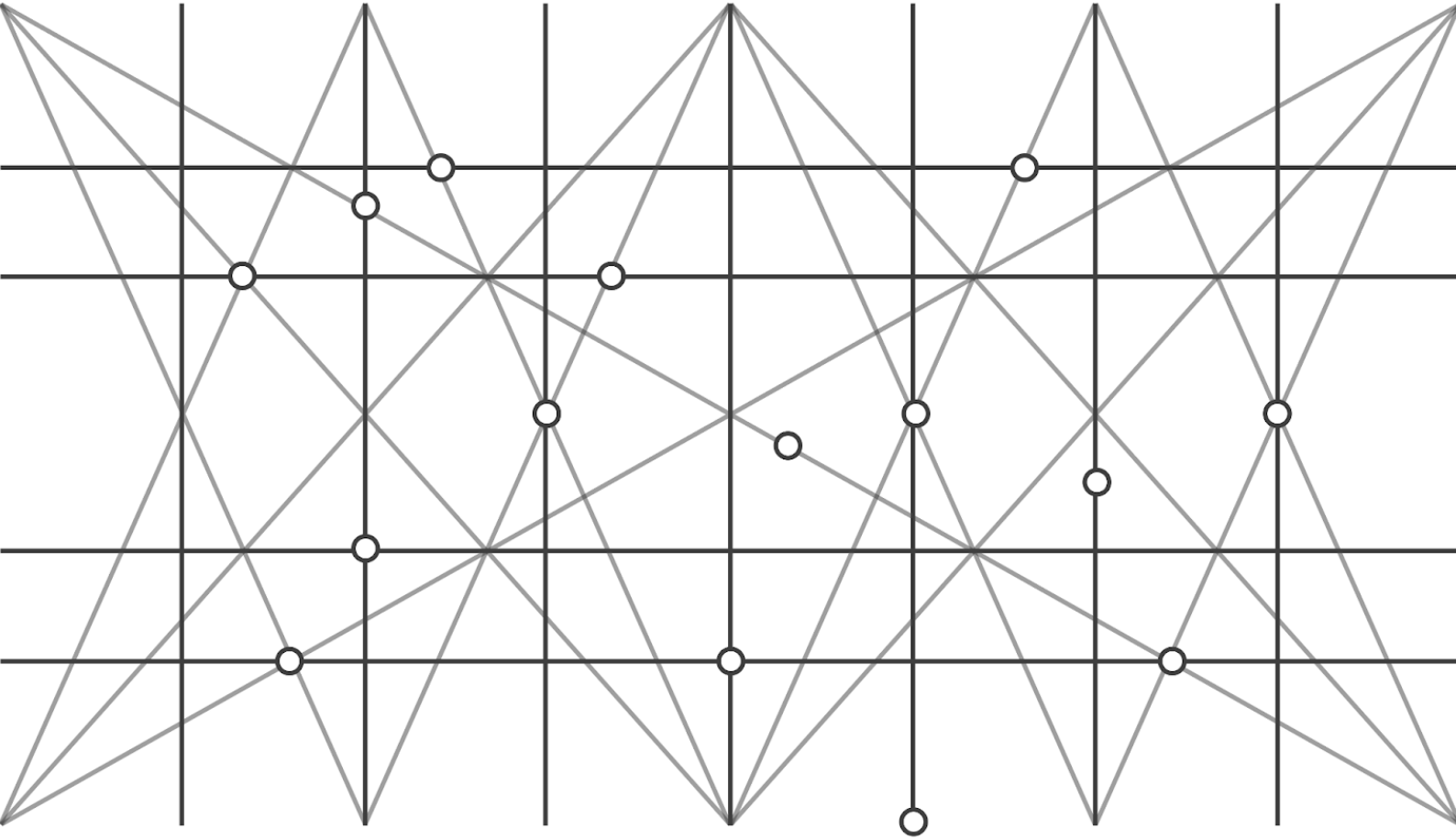


Figure 18.

Network of knowledge
and relationships

4.7. NETWORK(S)

The Network or fabric of this system(s) and the connections of individuals and knowledge that is shared through this network of individuals — represented in Figure 18, has a fundamental impact on the day-to-day operation and constant flow of shared context, and other interactional attributes that uphold human relationships. In fact, as a consequence of not activating such connections in these networks, we'll have manifestations of *corporate amnesia,*[70] reflecting inactivity of these connections or transactions when such networks are not connected, or have irregular and unilateral fluxes of information.

Different stages of the construction of these networks, that at early phases are built and positioned but their nodes are yet not active, or not connected, therefore not allowing fluxes or transactions in a fluid and organic fashion, are conditional

70. Kransdorf, Arnold. 1998. "Corporate Amnesia." European Business Review 98 (6).

to dynamics of managing (system keepers) actions or pro-active individual contributions, that spontaneously activate or connect without any explicit directive to do so.

This spontaneity is often a sign of a healthy and energized environment. Information repositories should act lively just like the activity of the network(s) that feed them.

This *atomization* is applied also to information and the interpersonal transactions required to circulate and scale; first, information repositories; second, human relationships. Through this light, we may reflect that every aspect of human interactions (represented in Figure 18) throughout the fabric of these systems are fundamental catalyzers of successful or unsuccessful transmission or reception of knowledge.

Transactional attributes and relationships gain even more relevance when multicultural teams are integral to this ecosystem, the construction of a shared vocabulary and handshake agreements are vital to a meaningful exchange of context and knowledge.

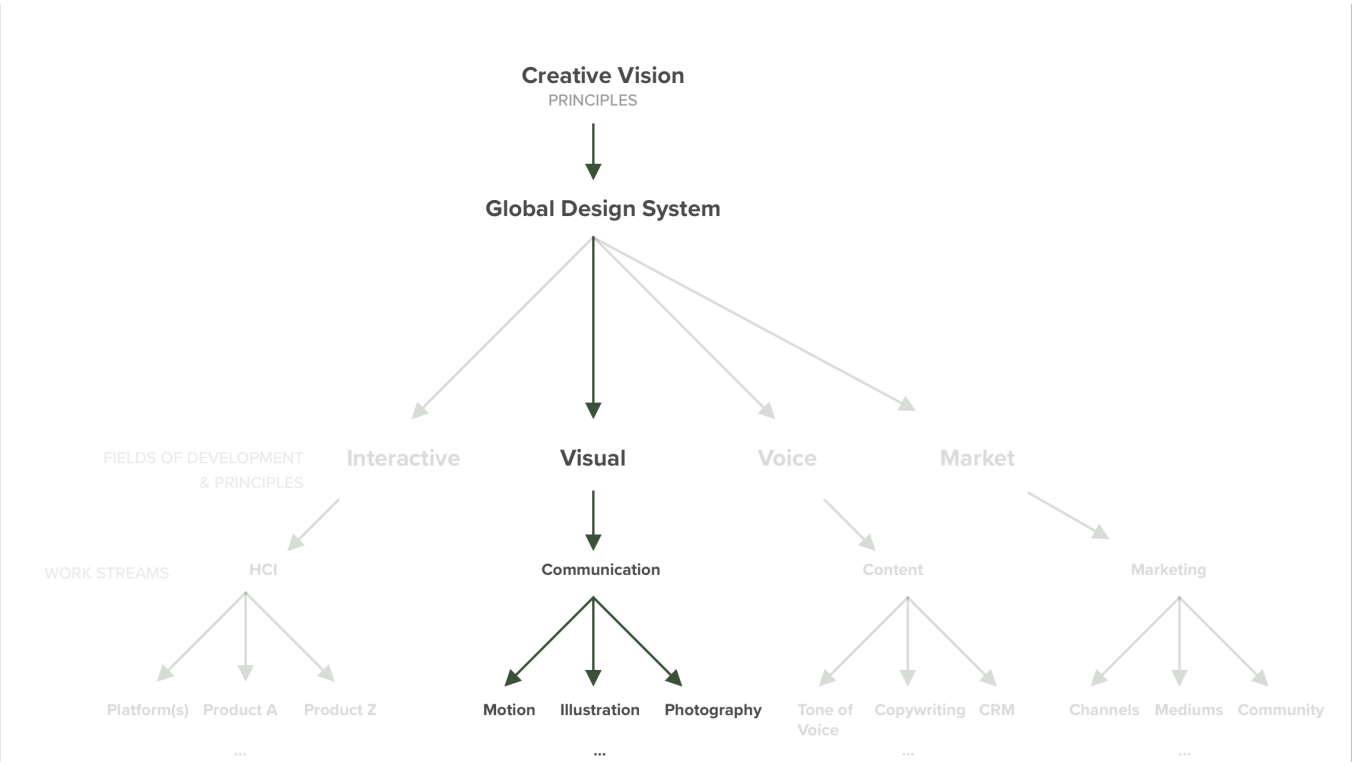


Figure 19.

Visual Communication Sub-System

5. DESIGN FOUNDATIONS

Following systemic and modularity principles, as guiding creative heuristics, other teams of contributors develop another branch of exploration from the Global Design System. The Visual branch of exploration. This development is made in open spaces, just like any other development from designers.

While we've approached with some detail the Interactive field of development, the Design Language created and propagated by the Global Design System, is a communication system that creates and uses a structured set of foundational guidelines composed by (but not exclusive) four main fields: interactive, visual, voice and market. This language defines the identity, strategy, purpose, tone, and reference to its products and users by creating and using conventional communication principles and signs.

Modularity greatly reduces the costs of experimenting with new designs. With modularity enforced, it is possible to change pieces of a system without redoing the whole. Designs become flexible and capable of evolving at the module level.[71]

5.1 VISUAL SUB SYSTEM

The visual subsystem is a component of the global design system, encompassing the principles, elements, and guidelines that govern the visual representation of an organization's brand, products, and services. It focuses on creating a cohesive and aesthetically balanced visual language that communicates the brand's identity and values consistently across various touchpoints and mediums.

5.2. MODULARITY

Two possible definitions of modular:

Employing or involving a module or modules as the basis of design or construction.[72]

Constructed with standardized units or dimensions for flexibility and variety in use.[73]

This modular approach is at the core of the ideation and developing phase of a brand identity, we can think of this attribute as being modular, just like a set of simple pieces or units that can be used and re-used to build bigger pieces, using a very similar approach to Atomic Design. A set of modular building blocks. These building blocks start in e.g. the form of design primitives:

- Principles
- Color
- Typography
- Space

And can evolve to:

- Communication & Visual Guidance
- Conversational patterns
- Visual patterns
- Experience patterns

71. Baldwin, Carliss Young, and Kim B. Clark. 2000. Design Rules: The Power of Modularity. MIT Press.
72. Dhar, Tapan K., and Luna Khirfan. 2017. "A Multi-Scale and Multi-Dimensional Framework for Enhancing the Resilience of Urban Form to Climate Change." Urban Climate 19 (January): 72–91.
73. "Modular Definition & Meaning | YourDictionary." n.d. Accessed January 12, 2023.

As an example, in the Sub HCIS, a button is built using these design primitives. This same button will be used to build bigger components and patterns e.g. product pricing cards, sign-in forms, client dashboards, etc.

So, let's see some of the benefits of using this modular approach:

- **Time**, reusable elements mean faster time to market — Fail faster, learn faster.
- **Consistency** reduces learning — users/contributors won't have to learn new representations for each task, and creates trust — delivers an experience that users can rely upon every time.
- **Focus**, focus on the problem-solving attributes of design, decoupling it from its aesthetic quality.
- **Scalability**, solving for challenges yet unaccounted, future proof
- **Collaboration**, creating and maintaining together a single source of truth for all the guidelines. Upholding a clear notion of shared ownership

So, having a defined problem(s), a set of principles, to create resolutions and solutions, a strategy is set to trigger ideas into action.

A brand creation, or a global identity, is (at least, it should be in our perspective) the first step towards a unified approach to problem-solving in collaborative networks of humans in contemporary society. With this said, let's bring some more definitions of what a brand is and how individuals and businesses are approaching this concept.

All visual form is made up of three categories of components: elements, characteristics and interactions. Visual elements are dots, lines, planes and volumes, and each element possesses characteristics of size, shape, texture and color. These elements and characteristics are directed by principles of visual interaction, which are position, direction and space.[74]

"In postmodern societies where individuals want to give name to their consumption, brands can and should be analyzed through various perspectives: macroeconomics; microeconomics, sociology, anthropology, history, semiotics, philosophy and so on"[75]

5.3. WHAT IS A BRAND?

Brands are everywhere in our lives, from the economy and society to culture, sports, and even religion. However, their widespread presence has led to increased criticism.

Kapferer suggests that a brand is a complex identity structure composed of "six interconnected facets: culture, personality, self-projection, physique, reflection, and relationship."[76] The physical aspect refers to the product's features, symbols, and attributes, while the personality aspect represents the brand's character and attitude. The relationship aspect represents the brand's associations and beliefs, and the cultural aspect encompasses the brand's values. The reflection aspect represents customers' perceptions of the brand, and the self-image aspect represents customers' internal image of themselves as users of the brand. Kapferer emphasizes that the brand is more than just the combination of these elements.

74. John Bowers in Introduction to Two-dimensional Design: Understanding Form and Function in Whitbread 2009

75. Kapferer, Jean-Noël. 2004. The New Strategic Brand Management: Creating and Sustaining Brand Equity Long Term. 2nd edition. London ; Sterling, VA: Kogan Page Business Books.

76. Ibid

An identity system is therefore a complex structure that ranges from abstraction to concrete and physical realms.

A strong brand identity helps to reinforce the message and meaning behind a brand for consumers and effectively communicates the brand's essence to other stakeholders. It also "encourages a more strategic approach to the brand."[77] At the foundational level of the strategy and construction of an identity system, there's an internal alignment purpose, where not only stakeholders but any core contributor to this system is in possession or creates information and adds value in a synchronous and symmetric way, in full alignment with the requirements, principles, and values of an entity or brand.

At a pre-inception level, a brand is just an idea, just a word, image, or emotion in a stakeholder's mind. The GDS addressed in figure 2 is, in our perspective, the first conceptualization of a holistic strategy towards the concretization of both operations (how is built) and materialization (what is built) of a brand, and consequent design language foundations that are particular to an identity system, and a direct response to a *why* of a problem statement.

So, the design foundations of a brand create and distribute a combination of elements such as imagery, language, and experiences that convey a company's identity, values, target audience, and purpose. The effectiveness of a brand is determined by how well these abstract concepts align with the tangible actions and outcomes experienced by its customers or end users.

77. Diefenbach, John. 1987. "The Corporate Identity as the Brand." Palgrave Macmillan Books, 156–64.

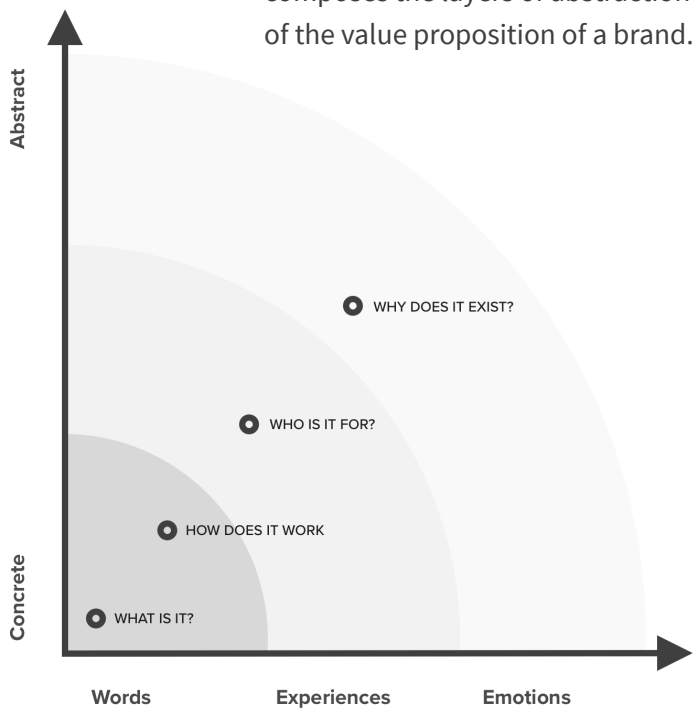
The weakness of brand as an identity system is the emphasis on desired positioning while less focus on perceived image. However, quantification of the role of image and identity is an issue need to be addressed. Also the tradeoff between them. This again brings us to the limitation of defining brand as an identity along with the issue of overlapping between the various definitions (e.g. Identity and image).[78]

5.3.1. LAYERS OF ABSTRACTION

Figure 20, exemplifies a traditional approach to a sequencing understanding of what composes the layers of abstraction of the value proposition of a brand.

Figure 20.

Layers of Brand Abstraction[79]



78. Maurya, U., and P. Mishra. 2012. "What Is a Brand? A Perspective on Brand Meaning." European Journal of Business

79. Ström, Matthew. 2020. “What Is a Brand?” March 4, 2020.

Figure 21.

Apple's *Think Different*[82]

5.3.2. WORDS

Early brands primarily used words, such as names or information, to communicate their message to consumers[80] where "printing advances made it far cheaper to reproduce colorful and distinctive labels."[81] This was the primary method of branding before the rise of visual brandings, such as logos and symbols. Using words alone to create a brand could be a powerful tool, as it allowed companies to create a unique and memorable name that could be easily recognized and remembered by consumers.

Additionally, early brands often used slogans or taglines as a way to communicate the benefits or unique features of their products. However, as visual branding became more prevalent, companies began to use a combination of words and imagery to create a more comprehensive and effective brand identity. Words can communicate the *why*, *what*, *how*, and *who*.

Apple's slogan, figure 21, is a powerful way to communicate *why*.

80. Moore, Karl, and Susan Reid. 2008. "The Birth of Brand: 4000 Years of Branding." Business History 50 (4): 419–32.
81. Low, George S., and Ronald A. Fullerton. 1994. "Brands, Brand Management, and the Brand Manager System: A Critical-Historical Evaluation." Journal of Marketing Research 31: 173–90.
82. "Think different" is an advertising slogan used from 1997 to 2002 by Apple Computer, Inc., now named Apple Inc. The campaign was created by the Los Angeles office of advertising agency TBWA\Chiat\Day in "Think Different" 2022

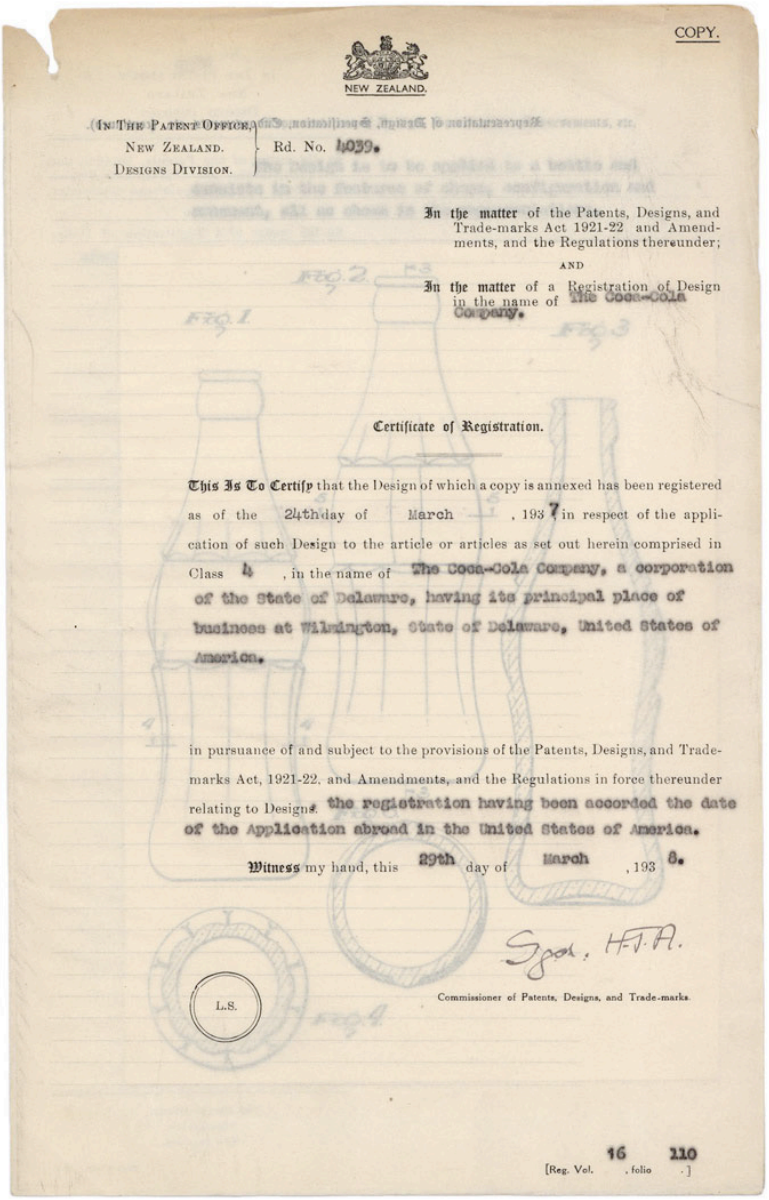
5.3.3. EXPERIENCE

Experiences are a key component of branding, as they allow brands to create a sensory and therefore emotional connection with their consumers. The use of colors, fonts, images, logos, videos, sounds, smells, and textures are all ways in which brands can communicate ideas and create a unique identity. For example, a brand may use a specific color palette to evoke a certain emotion or feeling, such as calmness or excitement. Similarly, a brand may use a particular font or typeface to convey a sense of elegance or modernity.

Motion, images, and logos play a crucial role in visual branding, as they serve as a visual representation of the brand and can be easily recognized by consumers. Videos and sounds can also be used to create a strong emotional connection with consumers, through the use of sound, music, and/or storytelling.

Smells and textures can also be used to create a sensory experience for consumers. For example, a brand might use a specific scent in its stores or packaging to create a memorable and pleasant experience for customers. Similarly, a brand might use specific textures in its packaging or products to create a sense of luxury or quality.

All these elements are carefully crafted and curated by brands to create a holistic and memorable experience for their customers, which enhances brand recall and recognition.



COPY.

NEW ZEALAND.

IN THE PATENT OFFICE,
NEW ZEALAND.
DESIGNS DIVISION.

Rd. No. 4039.

In the matter of the Patents, Designs, and Trade-marks Act 1921-22 and Amendments, and the Regulations thereunder;

AND

In the matter of a Registration of Design in the name of The Coca-Cola Company.

Certificate of Registration.

This Is To Certify that the Design of which a copy is annexed has been registered as of the 24th day of March, 1937 in respect of the application of such Design to the article or articles as set out herein comprised in Class 4, in the name of The Coca-Cola Company, a corporation of the State of Delaware, having its principal place of business at Wilmington, State of Delaware, United States of America.

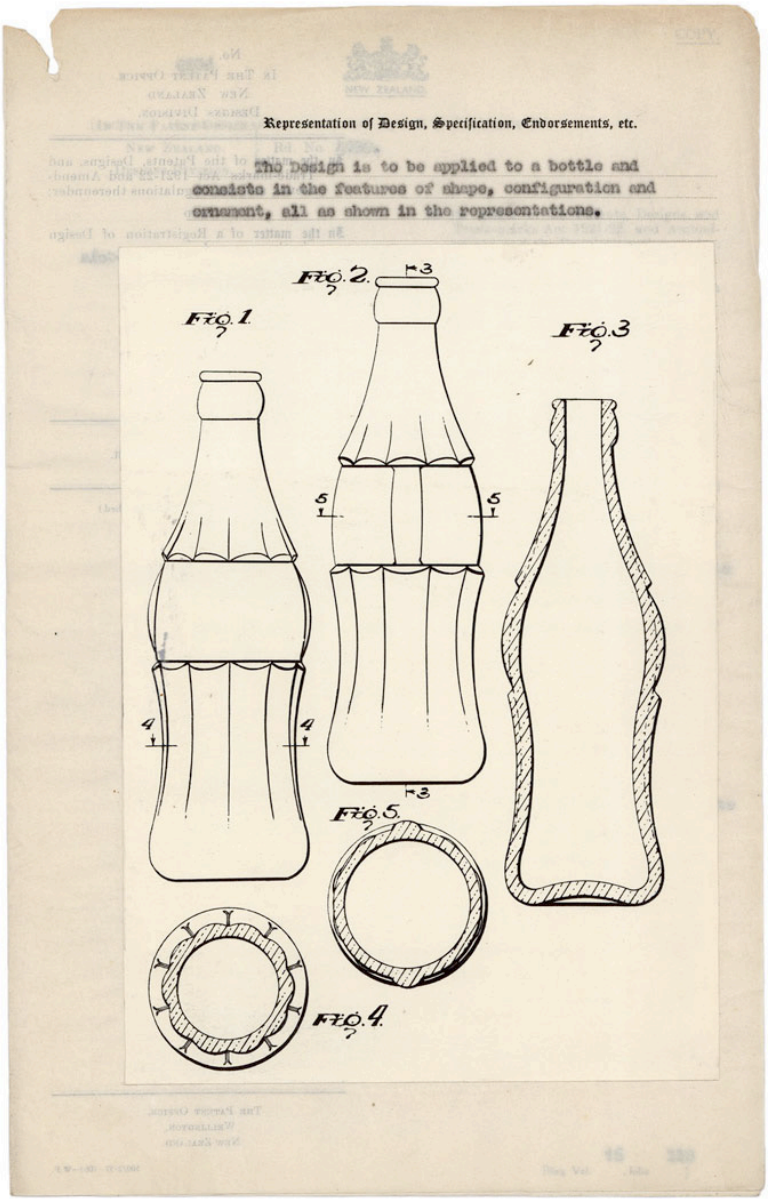
in pursuance of and subject to the provisions of the Patents, Designs, and Trade-marks Act, 1921-22, and Amendments, and the Regulations in force thereunder relating to Designs. the registration having been accorded the date of the Application abroad in the United States of America.

Witness my hand, this 29th day of March, 1938.

L.S.

Commissioner of Patents, Designs, and Trade-marks.

[Reg. Vol. 16, folio 110.]



Representation of Design, Specification, Endorsements, etc.

The Design is to be applied to a bottle and consists in the features of shape, configuration and ornament, all as shown in the representations.

Figure 22.

Design Patent for Coca Cola, in Archives New Zealand[83]

In the 1930s and 1940s, Coca Cola carefully crafted every aspect of their product, including the singular and ergonomic design of their glass bottles, the carbonation feeling touching the tongue, and the sound of the bottle opening, to convey the message that their drink was refreshing.

5.3.4. EMOTIONS

Tapping into a higher level of abstraction, where emotions are designed so that consumers will associate them with products or services.

The task of promoting a German car to Americans in the years following World War II presented a significant challenge for Volkswagen.[84] To overcome this, the company employed a minimalist approach in their advertising campaigns, highlighting their attention to detail and perfectionism. One notable example of this strategy was the Lemon ad, which featured

83. Archives New Zealand. 2014. Coke Bottle. Photo.
84. Matson, Marquis. 2020. "Make Them Cry (And Buy) With Inspiring Emotional Marketing." 2020.

Lemon.

This Volkswagen missed the boat.
The chrome strip on the glove compartment is blemished and must be replaced. Chances are you wouldn't have noticed it; Inspector Kurt Kroner did.
There are 3,389 men at our Wolfsburg factory with only one job: to inspect Volkswagens at each stage of production. (3000 Volkswagens are produced daily; there are more inspectors than cars.)
Every shock absorber is tested (spot checking won't do), every windshield is scanned. VWs have been rejected for surface scratches barely visible to the eye.
Final inspection is really something! VW inspectors run each car off the line onto the Funktionsprüfstand (car test stand), tote up 189 check points, gun ahead to the automatic brake stand, and say "no" to one VW out of fifty.
This preoccupation with detail means the VW lasts longer and requires less maintenance, by and large, than other cars. (It also means a used VW depreciates less than any other car.)
We pluck the lemons; you get the plums.

Figure 23.

Volkswagen's Lemon[85] Campaign[86]

a Beetle with a small defect on the chrome strip of the glove compartment, emphasizing the company's commitment to quality and their willingness to replace any imperfect vehicles. This approach helped to set Volkswagen apart from other car manufacturers and contributed to their success in the American market.

According to Simon Sinek's theory of value proposition, *Start With Why*[87] conceptual model theory is an explanation for the ability of certain individuals and organizations to inspire and differentiate themselves effectively. It posits that this is

85. Image in Heller, Steven. 2016. "Tall Tale for Small Car." PRINT Magazine. February 28, 2016.
86. "Lemon: Volkswagen Ad that Forever Changed America" in Koraza, Toni. n.d. "Lemon: Volkswagen Ad That Forever Changed America | MADX." Accessed January 16, 2023.
87. Sinek, Simon. 2011. Start with Why: How Great Leaders Inspire Everyone to Take Action. Reprint edition. UK USA Canada Ireland Australia India New Zealand South Africa: Portfolio.

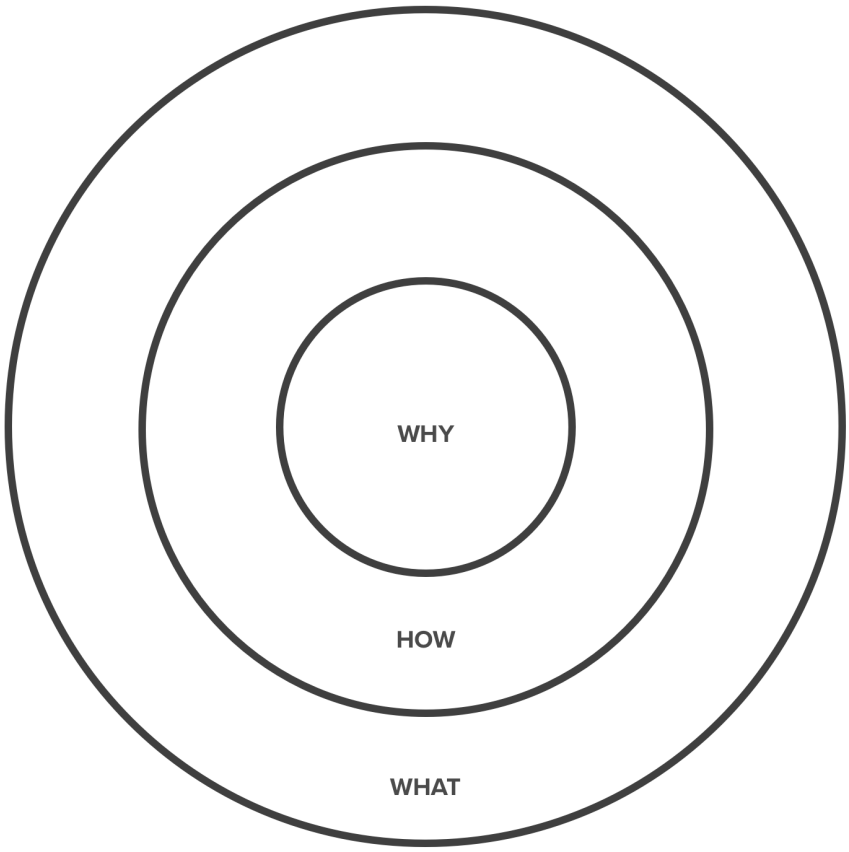


Figure 24.

The Golden Circle[88]

achieved by communicating with the parts of the brain that control emotions, behavior, and decision-making, which is supported by neuroscience. This model, allegedly, truly aligns a strategy with goals.

According to Sinek, the most crucial message that an organization or individual can communicate is their *Why* - the purpose or reason behind their actions. By *Starting With Why*, they can explain their motivation and inspire others to take action. Sinek's theory is that effectively communicating this passion connects with the listener's limbic brain, which is responsible for processing emotions such as trust and loyalty, as well as decision-making.

With this perspective in mind, we can thus conclude that this accomplishment and subsequent communication of it is performed *inside out*. This contradicts, fundamentally, the

88. Sinek, Simon. 2011. Start with Why: How Great Leaders Inspire Everyone to Take Action. Reprint edition. UK USA Canada Ireland Australia India New Zealand South Africa: Portfolio.

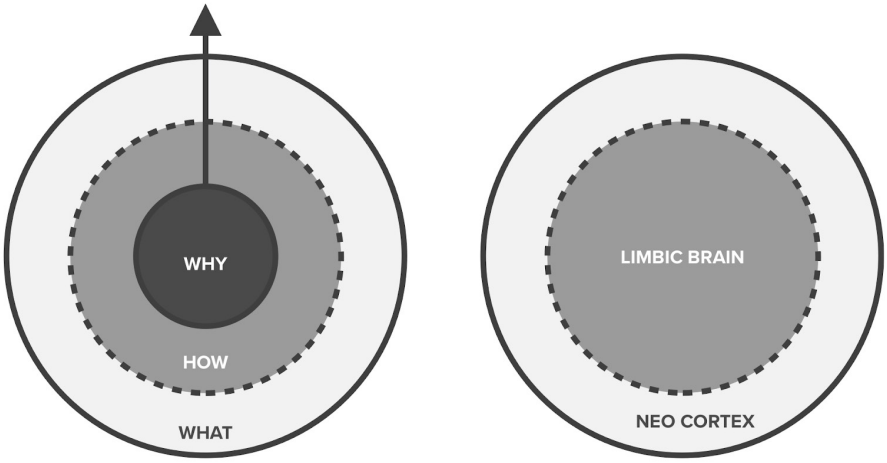


Figure 25.

Golden Circle + Human Brain[90]

initial information presented in a traditional sequencing, represented in figure 20, repositioning an emotional and abstract value proposition at the very core of a strategy for not only building, but communicating a set of abstractions internally, in a business environment, and externally, to the world.

This assertion is further reinforced by Anthony Villis, reinforcing that Sinek's Golden Circle theory is rooted in biology. Using a triune brain[89] conceptual model, the human brain is divided into three main sections that correspond to the levels of the Golden Circle. The top section, the neocortex, is responsible for rational and analytical thought and language, which corresponds with the What level. The middle two sections, the limbic brain, is where emotions like trust and loyalty originate, and it controls behavior and decision-making. However, it has no capacity for language. Therefore, communicating from the outside in, focusing on tangible actions and words, does not drive behavior. To be effective, communicators must start from the inside out, appealing to the limbic brain and leading with emotion rather than language.

Effective brands appeal to customers on multiple levels, including the more concrete level of words, the more abstract level of experiences, and the even more abstract level of emotions. Great brands not only explore these

89. MacLean, P.D. 1989 in Keyes, C. Don. 1991. "The Triune Brain in Evolution: Role in Paleocerebral Functions: By Paul D. MacLean. New York: Plenum, 1990, Xxiv + 672 Pp." Journal of Social and Biological Structures 14 (3):

90. Villis, Anthony. n.d. "(6) First Wealth's 'Why' – The Golden Circle | LinkedIn." Accessed January 15, 2023.

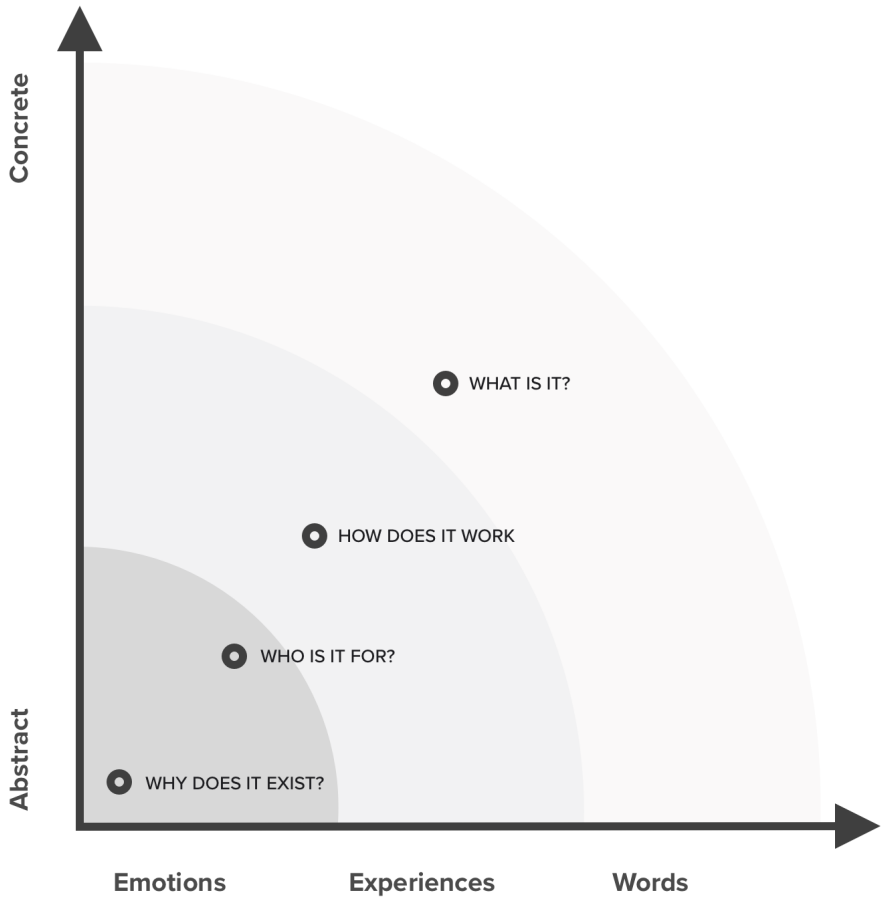


Figure 26.

Layers of Brand Abstraction re-sequenced

multiple levels of abstraction, but they reorder these layers starting from *Why*, thus having and communicating a clear purpose, internally — throughout internal business units — and externally — to end users. This means that the information contained in figure 20 is approached in reverse order, moving from abstraction to concrete, as depicted in figure 26.

This sequence, in this order, is integral to the core of the foundations of GDS and is amplified and replicated by the individuals' and teams' heuristic behavioral model(s). Every initiative, from small to large, contains a seed to this question or adverb: why?

From this point, and very briefly, we can assert that brands serve several functions for consumers, including:

- **Navigation**: helping individuals navigate and make choices among a variety of options.
- **Reassurance**: communicating the key attributes of a product

By "borrowing" the equity accrued by the corporate name, product lines becomes extension of corporate identity, as Tata exemplifies with the product portfolio of Tata motors all the products carry the name Tata with it e.g. Tata nano.[91]

or service and providing reassurance that the choice made is a good one.

- **Engagement**: using specific imagery, associations, and language to foster a connection and identification with the brand.

5.4. ARCHITECTURE

Brand architecture is the structure of relationships among a company's various brands and sub-brands. It implies multiple brands or products. It helps to define how a company's portfolio of brands should be organized and how they should relate to each other. This structure can include different levels such as a corporate brand, a master brand, and sub-brands. Brand architecture helps to create a clear and consistent message for customers, and it also helps to manage and organize a company's branding efforts. Well-designed brand architecture can also increase brand equity and lead to greater customer loyalty.

Brand architecture is important for a number of reasons:

Clarity and Consistency: A well-designed brand architecture helps to create a clear and consistent message for customers, making it easier for them to understand and remember the company's offerings.

Organizational Efficiency: Brand architecture helps to organize and manage a company's branding efforts, making it easier to develop and implement marketing strategies.

91. Maurya, U., and P. Mishra. 2012. "What Is a Brand? A Perspective on Brand Meaning." European Journal of Business and Management, February. p. 124

Increased Brand Equity: A strong brand architecture can increase brand equity by creating a sense of cohesiveness among a company's offerings, making it easier for customers to identify and remember the company's brand.

Greater customer loyalty: A well-organized brand architecture can lead to greater customer loyalty by making it easier for customers to identify and connect with a company's offerings and by providing a consistent experience across different products and services.

Flexibility: A good brand architecture allows for flexibility and scalability as a company grows, expands, or diversifies its product or service offerings.

Enhancing the value of the brand by creating a hierarchy among different products, services, or sub-brands and positioning them correctly in the market.

5.4.1. STRATEGY

A key decision in branding is whether to use a single, overarching brand or a portfolio of brands. This is a scenario that implies multiple products or brands under the same overarching entity or business. Companies like Unilever or Proctor and Gamble are examples of firms that use a house of brands approach, where each brand is distinct and operates independently. On the other hand, some Business-to-Business (B2B) firms like DuPont and Siemens

have a portfolio of brands, where multiple brands are affiliated with a parent company but are marketed separately to different customer segments. For example, P&G has a wide range of products and sub-brands, such as shampoos (Head and Shoulders, Pert, and Pantene), toothpaste (Crest), and toilet paper (Charmin), among others. Each of these brands is targeted at different customer segments and is positioned based on different value propositions.

Strategically, these are very different decisions. There are tradeoffs with each approach. For the house of brands, the cost is very high each time a new brand is established. There are substantial costs to introducing a new name and defining its meaning to its targeted customers. It takes additional time before the product gets established in the market.

Choosing between a branded house and a house of brands is then a key strategic decision that comes with tradeoffs. In a house of brands approach, creating a new brand incurs a high cost. Establishing a new name and building its meaning with target customers requires significant resources and time before the product can gain market acceptance. On the other hand, using a house of brands approach allows a company to take different positions for each individual brand, as it is not limited by the image or reputation of the corporate brand or other brands in the portfolio.

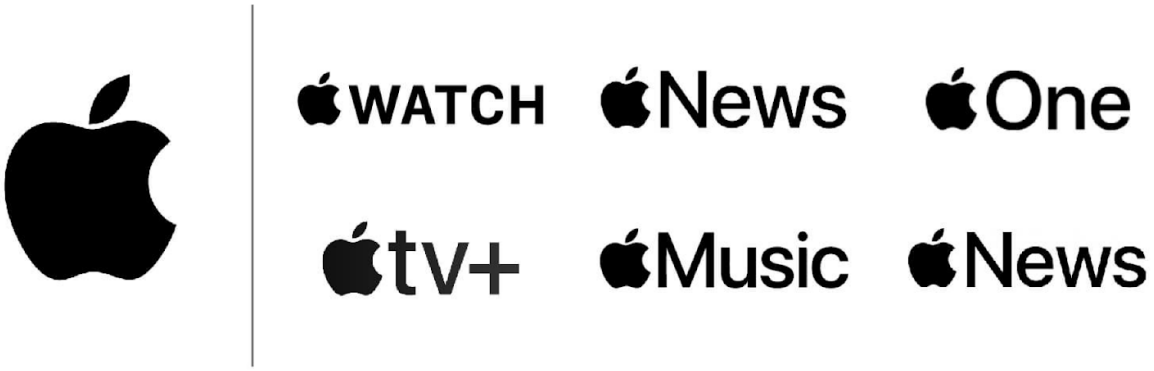


Figure 27.

Apple, an example[92] of Branded House Architecture

Advantages of the Branded House:

- Sub-brands boost the master brand through consistent visibility, resulting in increased overall brand equity
- Clarity and visual unification reduce confusion for consumers and strengthen association with the master brand's qualities
- Cost-effective and efficient, as only one marketing and brand strategy are needed for all offerings

Disadvantages of the Branded House:

- Negative performance of a sub-brand can harm the master brand's reputation and organization's reputation
- Risk of dilution of the master brand as the organization offers products or services in multiple categories
- Inflexible and costly to build overall brand equity if sub-brands underperform

Advantages of the House of Brands:

- Allows for diversification of business portfolio and increased reach by targeting different audiences and using different pricing strategies
- Freedom to enter new markets without affecting other brands, allowing for more risk-taking with a new product or service offerings
- Reputation of the organization is kept secure, limiting backlash in case of underperformance or reputational damage of a sub-brand

92. Williams, Adam. 2021. "The Importance of Brand Architecture for Your Sub Brands." Magneti. September 7, 2021.

Figure 28.

Proctor and Gamble, an example of House of Brands Architecture[93]

"A clear advantage of having a portfolio of brands is that if there should be a public "failure" it is desirable to have the other products in the company's portfolio protected."[94]

Disadvantages of the House of Brands:

- Expensive as the organization must build each brand from scratch with a distinct brand and marketing strategy
- Brands cannot rely on the parent brand's reputation to boost their own reputation, leading to potential perception as ordinary companies
- Potential confusion among consumers as to what represents the company

While this so far apparently surfaces a binary categorization for a decision-making process, figure 29, below in this text, illustrates that there is a spectrum of global branding strategies, and it is not a binary choice between *houses of brands* and *branded houses*. Instead, there are various intermediate positions.

Intermediate positions can be approached as a Hybrid Brand Architecture.

Advantages of a Hybrid Brand Architecture:

- Combines the benefits of both House of Brands and Branded House, such as flexibility and awareness for new offerings and parent brand reputation
- Facilitates launching new sub-brands in untapped market segments

Disadvantages of a Hybrid Brand Architecture:

- Inherits drawbacks of both models, such as inflexibility, reputation risk, additional expenses and management time

93. Ibid
94. Reibstein, David. 2005. "House of Brands vs. Branded House." Economist, Global Agenda 3 (January): 175–77.

Figure 29.

Marriott, an example[95] of Hybrid Brand Architecture

- Can confuse consumers as sub-brands may be associated or disassociated with parent brand
- Can be challenging for the design and marketing business units to keep brand identities updated and maintain consistency across the company's portfolio.

For the sake of simplicity, this paper will not be diving into the detail of hybrid brand architectures such as e.g. *sub-brand or endorsed brand*.[96]

A *House of Brands* architecture allows for more flexibility in branding, as it separates the parent brand from the individual *standalone* child brands. This allows for each child brand to have its own distinct visual representation. On the other hand, a *Branded House* architecture incorporates the parent brand into all child brands, leading to a stronger emphasis on the master brand's visual representation across all products and sub-brands.

5.4.2. DYNAMICS IN BRAND ARCHITECTURE

Figure 29, depicts the graphical identity and business strategic dominance of a master brand through the spectrum of separation between the edge concepts of brand architecture.

The approach to a separation spectrum should also be seen through a temporal lens, where different strategies are positioned, and should also suggest a dynamic

95. Williams, Adam. 2021.

96. Hsu, Liwu, Susan Fournier, and Shuba Srinivasan. 2016. "Brand Architecture Strategy and Firm Value: How Leveraging, Separating, and Distancing the Corporate Brand Affects Risk and Returns." Journal of the Academy of Marketing Science 44 (2): 261–80.

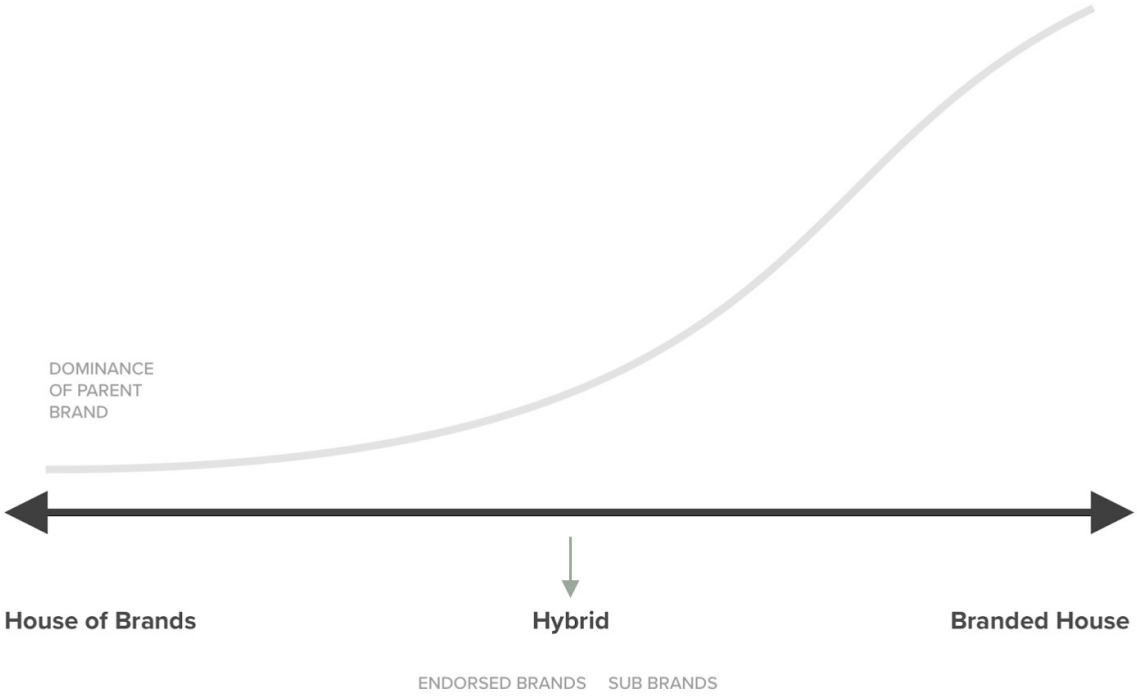


Figure 30.

Brand Architecture Spectrum

dimension to the concept of brand architecture.

The work developed by Laurent Muzellec and Mary C. Lambkin, brings awareness to these two types of branding strategies: integration and separation models that are constantly evolving and adapting to change, and providing guidance to the decision-making process on which strategies to take with the recurrence of new or different conditions over time.

"This framework considers the vertical dimensions of the brand architecture and tries to show how changes at any one level reverberate to other levels. This framework paints a picture of the brand architecture as a dynamic model with constant change and evolution, as companies manage their portfolios of products and brands over time"[97]

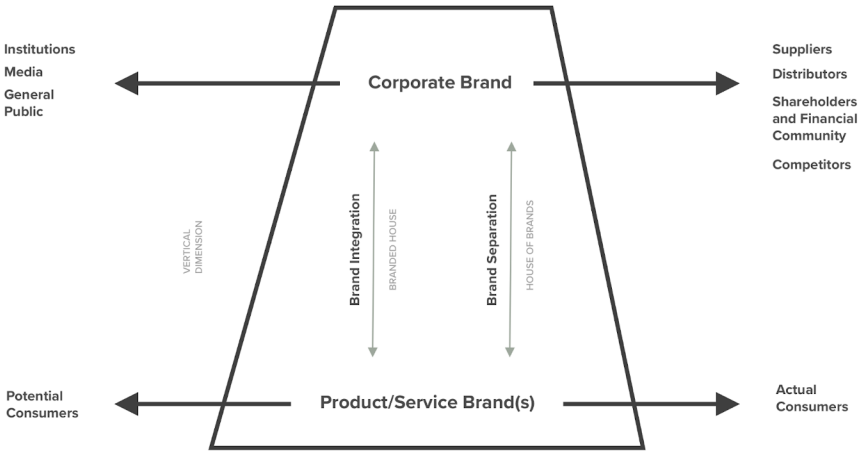


Figure 31.

A Dynamic Model of Brand Architecture Management[98]

97. Muzellec, Laurent, and Mary C. Lambkin. 2009. "Corporate Branding and Brand Architecture: A Conceptual Framework." Marketing Theory 9 (1): 39–54.

98. Muzellec et al. P. 43.

6. A DESIGN LANGUAGE

6.1. WHAT IS A DESIGN LANGUAGE?

A design language is a set of visual, interactive, voice, and other elements that are used consistently across a product or brand. It includes *tokens* like typography, color, iconography, layout, and other elements that create a cohesive look and feel for a product or brand. A design language helps to establish a visual identity, create a consistent user experience, and make it easier to design new features and products by the reuse of design tokens or primitives, which are the building blocks, analogous to an alphabet for the written language.

Following the written language analogy, this language implies rules or guidelines to apply and combine simple abstractions to build meaning in a structured and conventional way. Semantics refers to the meaning of words and phrases, while syntax refers to the arrangement of words and phrases to form grammatically correct sentences. Grammar is the set of rules that govern the structure of sentences in a language.

In a Design Language, we'll argue that the scaling of such meaning attribution and construction structures follows a similar pattern, towards the construction of designed communication vocabulary.

A Design Language expresses itself in different communication fields, which in this particular field, the Visual Sub System, takes the form of tangible visual signs that a user first takes contact

A central puzzle that people face, from a design perspective, is how to make communication possible that was once difficult, impossible or unimagined.[99]

"The systematic appearance of typography, symbolism, color, layout and sequencing constitutes a visible language. Corporate identity programs establish the system and record it within graphic design standards manuals, in effect the source code for the graphic design algorithm."[100]

with regarding an interface or experience with a brand.

The codification and grouping of these attributes that compose a design language, through a shared methodology, intersecting different disciplines and areas of specialty, in a creative ecosystem, is the very core of interest of this text .

6.2. DESIGN IDENTITY MANUAL

A Design Identity Manual (DIM) is a document or group of documents, that can take digital and/or physical mediums as supports, that outlines the design principles and guidelines for a company's visual identity. It serves as a reference for designers, marketers, and other stakeholders on how to use the company's design elements, such as logo, typography, color palette, and imagery consistently across different mediums and platforms. The DIM typically includes information such as design inspiration, style guidelines, usage of the logo, typography rules, color palette, imagery guidelines, and how the design should be applied to different applications such as advertising, packaging, digital, and print materials. The purpose of a DIM is to ensure consistency and cohesiveness of the company's visual identity so that it is easily recognizable and its message is clearly conveyed to its target audience.

"Corporate visual identity is the graphic design at the core of a firm's visual identity. Corporate visual identity is the outer sign of the inward commitment of a company. In other words, corporate visual identity is an assembly of visual cues by which an audience can recognize the company and distinguish it from others."[101]

99. Aakhus, Mark. 2007. "Communication as Design." Communication Monographs 74 (1): 112–17.

100. Marcus, Aaron. 1984. "Corporate Identity for Iconic Interface Design: The Graphic Design Perspective." Interfaces in Computing 2 (4): 366.

101. Melewar, T.C. 2003. "Determinants of the Corporate Identity Construct: A Review of the Literature." Journal of Marketing Communications 9 (4): 195–220.

Visual communications of any kind, whether persuasive or informative, from billboards to birth announcements, should be seen as the embodiment of form and function: the integration of the beautiful and the useful.[102]

This section of the Visual Sub System aims to describe why and how the foundational attributes of identity are created and structured for reference and guidance purposes.

6.2.1. SYMBOLISM

"According to the language of semiotics, (...) signs may be iconic (representational) or symbolic (abstract)."[103]

"A signal can be stimulus that does not mean anything but causes or elicits something; however, when used as the recognized antecedent of a foreseen consequences it may be viewed as a sign, inasmuch as it stands for its consequent (as far as the sender is concerned)."[104]

The term symbolism is used here in a broad sense to encompass all forms of non-verbal communication, including marks, monograms, pictograms, illustrations, photographs, and diagrams. The goal is to approach an idea of system graphics with careful consideration of the specific communication needs of each visual artifact, while also ensuring that a consistent visual style is maintained throughout the ecosystem of a GDS.

The design of symbols, logos, ideograms, and pictograms is a fundamental development front of the Visual Sub System. These elements are used to convey the overall identity of a corporation through its corporate symbol, and sub-symbols that are arranged in an iconography collection, to aid consumers in identifying and using the corporation's products through, interfaces, products, packaging signs, and to assist visitors in navigating the corporation's physical and digital spaces through architectural or urban signs or digital platforms user interfaces and experiences.

Symbols represent the first touch point of recognition for non-verbal communication and operate at a more subliminal level. A symbol codifies a universal

102. Rand, Paul. 2014. Thoughts on Design. Chronicle Books. 9.
103. Marcus, Aaron. P. 367
104. Eco, Umberto. 1976. A Theory of Semiotics. Indiana University Press. p.48

meaning or implies a concept that is to be decoded by the viewer. It is, therefore, efficient on the amount of visual and artifact information weight infrastructure required to transmit information and therefore potential to reinforce the singularity of a corporate identity.

An example of such an application of meaning for non-verbal communication can be seen in figure 32.

Figure 32.

Apple logo[105] Symbol[106] benchmark

6.2.2. COLOR

Color refers to the visual perception of different wavelengths of light. It is the result of the way that our eyes and brain interpret the reflection, absorption, or transmission of light. The colors we see are a result of the way that the eye's retina processes light waves of different wavelengths. The color spectrum includes red, orange, yellow, green, blue, indigo, and violet. Color can be described in terms of hue, saturation, and brightness/value.

Hue is the name of colors, such as red, blue, and green. Saturation is the intensity or purity of the color. Brightness or value is the lightness or darkness of the color.

These three dimensions of color, hue, saturation, and brightness, are instrumental attributes in the creation of color sub-systems that also have non-

105. Design by Janoff, Rob 1977.

106. Unraveling the Tale behind the Apple Logo | CNN." n.d. Accessed January 18, 2023.

verbal communication capabilities in allocating meaning to visual artifacts.

The construction of identity is also possible by inferring meaning from the use of pure color.

Clear guidance towards color usage is a fundamental criterion in Global Design Systems, as in all sub-systems included in these methodologies. Color is a transversal design token that feeds the sub-structures of information of different fields of problem-solving in such ecosystems.

Comprehensive color frameworks provide guidelines and best practices for creating consistent and cohesive visual identities across all touchpoints for a brand or organization, are developed and distributed through these systems, sharing detailed instructions on how these design primitives are used, including color palettes, sub-color palettes and their applications on visual and communication elements as for user interface and experience building and *meaning* attribution.

Color is, therefore, a transversal design token that feeds the sub-structures of information of different fields of problem-solving in such ecosystems. This means that color is a versatile design element that can be used across various fields and applications, such as branding, marketing, and user interface design. It is a fundamental or atomic design token that can be used to communicate information and create an emotional connection with the user or audience.

The corporate graphics approach to color emphasizes the selection of a limited set of well-chosen colors that meet the criteria of production, the needs of the content and the preferences or limitations of the viewers. These colors are used repetitively to maintain consistency across content areas and across different display media.[107]

"Color may be a critical factor that creates a certain association in the market in consumers' minds. That is to say, color is highly influential on consumer association processing when consumers form an association with a corporation or a brand."[108]

Global Design Systems are essential for creating cohesive and consistent visual identities, and color is an important element that helps achieve this goal. By providing clear guidance on color usage, these systems ensure that all brand touchpoints are aligned and that the audience can easily recognize and remember the brand.

6.2.3. TYPOGRAPHY

Typography is another atomic element in Global Design Systems, as it plays a crucial role in creating a cohesive and consistent visual identity for a brand or organization. Typography, in the context of a Visual Sub System, refers to the design and guidelines for the use of typefaces, font families, and other elements that make up the written word in a design or communication.

Bellantoni and Woolman[109] argue that printed text has two levels of meaning: the word image, which is the concept represented by the word itself, and the typographic image, which is the holistic visual impression created by the word's appearance on the page or other support.

In Global Design Systems, typography is used to create a visual hierarchy and establish a clear hierarchy of information. This is done by designing or selecting specific typefaces and font families that align with the brand's values and messaging.

In addition to creating a visual hierarchy, typography is also used to create a sense of continuity and cohesiveness

107. Marcus, Aaron. P. 368

108. Jin, ChangHyun, MoonSun Yoon, and JungYong Lee. 2019. "The Influence of Brand Color Identity on Brand Association and Loyalty." Journal of Product & Brand Management 28 (1): 50–62.

109. Bellantoni, Jeff, and Matt Woolman. 2000. Type in Motion Innovations in Digital Graphics. London Thames & Hudson.

across all brand touchpoints. This is done by establishing a consistent typographic style, such as using the same font family and font sizes, and by ensuring that typography is used consistently across all touchpoints, such as in print materials, digital materials, and packaging.

Typographic scaling and styling is built in sub-systems for optimal usage in different scenarios and supports. Typography is also an important element in creating accessibility in design. Human Computer Interaction Systems usually consider typography as a way to ensure readability, legibility and accessibility to the design across different platforms and devices. This includes setting a minimum size for text, providing adequate line spacing, and choosing font styles that are easy to read and accessible through multiple reading applications and localizations.

Type plays a crucial role in creating a cohesive and consistent visual identity for a brand or organization. By providing clear guidance on typography usage, Global Design Systems ensure that all communication touchpoints are aligned and that the audience can easily read and understand the information presented.

Typography, at the core of problem-solving and an integral part of the systemic framework, not only serves a functional purpose in conveying information, but also has semiotic value as it shapes the meaning and interpretation of the text through its visual design.

"Typographic communication in the form of maps and signs was not only key to the organization and manipulation of patterns of transportation but also to patterns of work and life throughout the city."[110]

6.2.4. GRID

A grid, refers to a structure used to arrange design elements consistently and effectively. It provides a visual framework for organizing content, such as text and images, on a page, screen or space. The grid defines, mainly but not only, the arrangement of columns and rows, and serves as a guide for positioning elements within a certain space.

According to Ellen Lupton, grids are "means for generating form."[111] Grids organize content and are often used in different creative environments, such as graphic design, web design, and typography, and can range from simple two-column layouts to complex multi-column systems. They can be based on fixed or flexible units of measurement, and are intended to create harmony, balance, and proportion.

This systemic usage of space is "a strong foundation for a design system, ensuring visual consistency"[112] through the pondered use of space and empty space. The use of empty space, also known as white space or negative space, is an important aspect of grid systems in design. Empty space serves as a visual element in its own right and can greatly impact the overall composition goals and visual hierarchies.

Empty space can also help to draw the viewer's gaze to specific elements in the support, making them more prominent and easier to understand. It also provides silence and allows the elements

110. Golec, Michael J. 2012. "Helvetica and the New York City Subway System: The True (Maybe) Story." Journal of Design History 25 (1): 108.

111. Lupton, Ellen, and Jennifer Cole Phillips. 2015. Graphic Design: The New Basics. 2nd edition. New York : Baltimore:

112. Kholmatova, Alla. 2017. Design Systems: A Practical Guide to Creating Design Languages for Digital Products. Smashing Media AG.

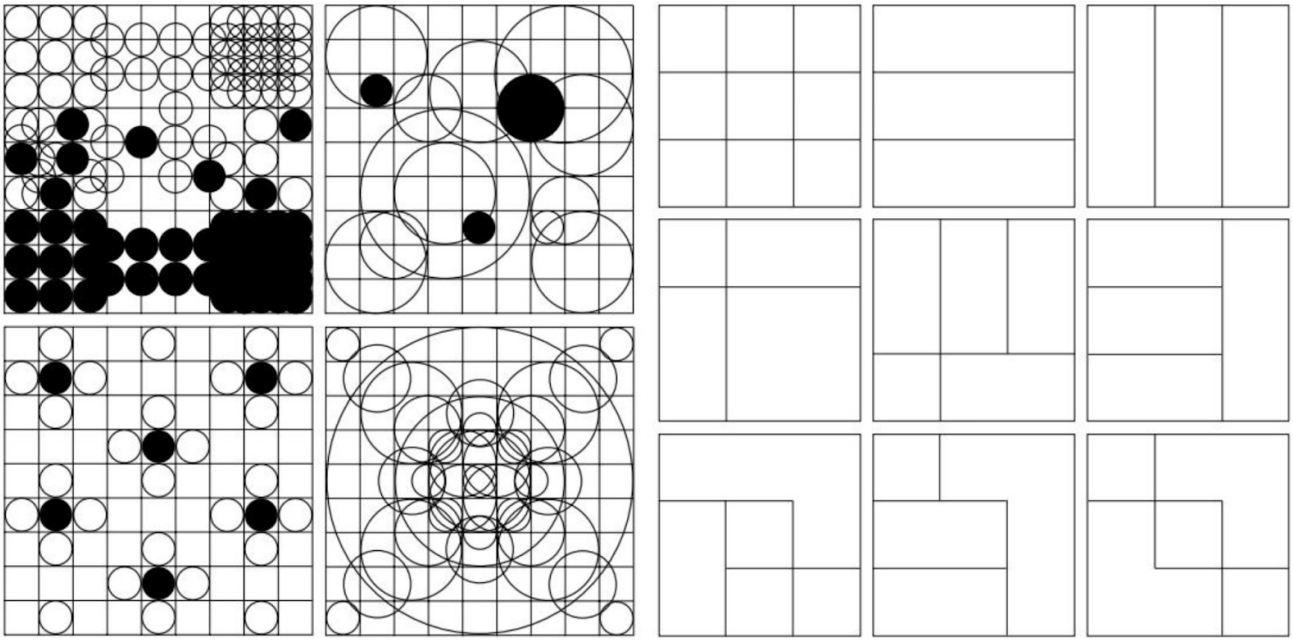


Figure 33.

"Grids Generate Form"[117]

in the design to be more easily acquired and rendered by the viewer.

"The use of empty space is of utmost importance for the clear formation of the design and its content."[113] In her book Graphic Design: A New History, historian and graphic designer Stephen Eskilson states that "emptiness can be as important as fullness in determining the visual balance of a design."[114]

In programming environments, such as Bootstrap,[115] grids are a key component of a framework for building fluid and responsive content. Bootstrap's grid system[116] is a flexible and responsive layout system that serves as a tool for designers and developers to create uniform and consistent designs.

Additionally, the building blocks used to construct grid systems can transition seamlessly from static to dynamic settings. This implies that a design's foundational elements can already incorporate the necessary units of a grid system to create a visual identity that can be expressed across both physical and digital platforms.

113. Müller-Brockmann, Josef, Muller-Brockmann, and D. Q. Stephenson. 1996. Grid Systems in Graphic Design: A Visual Communication Manual for Graphic Designers, Typographers and Three Dimensional Designers. Niggli.

114. Eskilson, Stephen. 2007. Graphic Design: A New History. New Haven: Yale University Press.

115. Mark Otto, Jacob Thornton, and Bootstrap. n.d. "Introduction." Accessed May 22, 2023.

116. Mark Otto, Jacob Thornton, and Bootstrap. n.d. "Grid System."

117. Image from Jason Okutake and John P. Corrigan, MFA Studio in Lupton, Ellen, and Jennifer Cole Phillips. 2015. Graphic Design: The New Basics. 2nd edition. New York : Baltimore: Princeton Architectural Press.:176

6.2.5. LAYOUT

Layout is the arrangement and orchestration of visual elements on a page, screen, space, or any other medium. This ordered gesture is an essential component of any design language.

Research performed on the field of Graphic User Interface (GUI) design, highlights the fundamental aspect of layout in the construction and architecture of visual information.

Such studies take e.g. "the amount of information, density, alignment, and zoning or grouping indications"[118] to form an hypothesis, that relative weight and impact of visual factors on the performance of a visual search task can differ in web page design due to the emphasis placed on dynamic content and information over consistent structure(s). Taking on the dynamic nature of such a medium, such as web pages, that often prioritize the presentation of up-to-date and relevant content, which can vary in its placement and presentation. As a result, visual elements such as images, typography, and color may have varying degrees of influence on the user's ability to locate and process information, which can degrade or upgrade the user's experience in fetching, processing and understanding information.

Therefore, understanding the dynamic nature of layout design in mediums such as web pages, apps, any digital support, and the impact of visual factors can help designers create effective and user-friendly interfaces.

118. Parush, Avi, Yonit Shwarts, Avy Shtub, and M. Jeya Chandra. 2005. "The Impact of Visual Layout Factors on Performance in Web Pages: A Cross-Language Study." Human Factors 47 (1): 141–57.

The object of typography is communication. The point of it is to make the reading experience as easy and pleasurable as possible, so that the reader is not distracted by the act of reading, but is absorbed in the message.[119]

Robert Bringhurst describes layout as "the creation of visual order." A well-designed layout should balance the visual elements, including typography, images, and white space, to create a harmonious and readable design.

Layout is under the influence of previously described pillars of a design language, such as a grid system, typography, color as attributes to compose, visually, meaning in a potentially systematic way.

The purpose of layout in a design language is to create an organized and visually appealing composition that effectively communicates the intended message.

6.2.6. MOTION

Adding a fourth dimension to the explored visual and spatial dimensions, in the previous sections, brings a fundamental attribute to meaningful visual communication: time.

Motion is not only critical for enhancing user experience and engagement but also has the potential to expand the reach of information and therefore create a universal language. Motion has the ability to cross written language barriers and convey information and emotions to users from diverse cultures and languages, this implies a more inclusive user experience by enabling users from various backgrounds and languages to engage with a particular brand's attributes,

119. Bringhurst, Robert. 2002. The Elements of Typographic Style. 2nd Edition. Point Roberts, WA: Hartley & Marks.

"The repetition of elements, such as circles, lines and grids, creates rhythm, while the variation of its size or intensity generates surprise. In animation, designers should simultaneously orchestrate the visual and sound rhythms."[120]

message or interface that enables access to particular product or service in a significant and joyful manner.

From interaction techniques, such as *micro-animations* in button animation, progress indicators and hover effects to visual cues such as animations, transitions using i.e. symbolism; color; typography can be used to reinforce and communicate information and emotions to users.

E. Lupton ties a critical aspect of communication, sound, to visual orchestration and rhythm construction. This connection can be argued to promote an efficient and delightful process of information acquisition and interpretation. This assumption is of imposing value, but for the sake of simplicity, the current work will focus on this orchestration and choreography at a visual level only. Knowing that for a thorough in depth exploration, we would have to look at this audio medium in a much more detailed and contextualized analysis that should open up a much larger research with direct impact at the core challenge of this text scope and time to be produced.

Orchestration refers to the arrangement of different elements within a communication space, such as typography, imagery, and sound. By carefully orchestrating these elements, and providing guidelines to others to do the same, designers can create a seamless and compelling visual narrative that captures the user's attention and guides them through an experience.

120. Lupton, Ellen, and Jennifer Cole Phillips. P. 34

Choreography, on the other hand, refers to the movement and interaction of different elements within a motion design. Here, we're looking at a sense of rhythm and flow that enhances the user's engagement with the interface at smaller scales. This functions at the lower level of a visual narrative and can affect local artifacts or components that act as keyframes of a bigger orchestration.

Transition is a powerful technique that enables and connects the notion of states while navigating digital interfaces, e.g. "animate the transition between states so that it looks smooth, not discontinuous. This helps keep the user oriented. We can guess that it works because it more closely resembles physical reality".[121]

Motion as a guiding principle can be observed in user interface and user experience exploration that operates at more abstract levels. For instance, the use of dynamic images and spatial cues can prompt or indicate to the user certain patterns of exploration or directions in an experience or journey that lead to accomplishing a goal or a set of goals. Visual rewards can be generated as a result of successfully completing a sequence of steps towards these personal achievements, and the fluidity and joyfulness of the journey to get there can be seen as a reward in itself.

6.3. TONE OF VOICE

This sub system applies systematic heuristics to verbal

121. Tidwell, Jenifer. 2005. Designing Interfaces: Patterns for Effective Interaction Design. First Edition. O'Reilly Media. P. 128

communication. This in turn injects value and direction at the very initial ideation sessions that are needed to kickoff creative work.

In 1951, J.W. Young outlined[122] a five-step process for generating advertising ideas. The first step involves gathering raw materials, namely facts. The second step involves mentally working over these materials, followed by an incubation period. The idea for the advertising message is then born, leading to the final step of developing the idea.

Although our discussion of communication and copywriting will have a global perspective and include traditional advertising methods employed by agencies, our main focus will be on creating guidelines and heuristics for digital platforms. These guidelines may have the potential to be scaled and applied to other contexts and touch points.

The verbal medium is an essential support for communication. This sub system articulates all written, semantic and grammar involved in expressing any kind of information and refers to the way a brand or organization communicates its message to its audience. As a sub system of a Global Design System, Tone of Voice plays a crucial role in creating a consistent and recognizable design identity.

By addressing a concept of *Tone of Voice*[123] (ToV), a brand can build trust and credibility with its audience, and create a strong emotional connection that sets it apart from competitors.

122. In Marsh, Charles. 2007. "Aristotelian Causal Analysis and Creativity in Copywriting: Toward a Rapprochement Between Rhetoric and Advertising." Written Communication 24 (2): 168–87.

123. Oh, Jeyoung, and Eyun-Jung Ki. 2019. "Factors Affecting Social Presence and Word-of-Mouth in Corporate Social Responsibility Communication: Tone of Voice, Message Framing, and Online Medium Type." Public Relations Review 45 (2): 319–31.

Great copywriting has the ability to deliver messages of value to the right people at the right time[124]

This sub system establishes guidelines for how it is used across all channels and touchpoints, internally and externally. This includes everything from social media posts and marketing materials to customer support communications and internal messaging.

Following a systemic approach, this branch of the GDS uses the same framework to create a set of foundations on which work is developed and documented with guidelines for further iteration, consistent application and scalability. From the existing information available on parallel streams of work, a set of principles are defined, and from this definition an elemental architecture blueprint for written communication is set.

6.3.1. USER INTERFACE AND MICROCOPY

On digital mediums, UI and microcopy have a crucial role in facilitating user interaction and helping them navigate through content and digital spaces. It's not only about providing clear instructions, but also about guiding, tempting, and inviting users to follow a specific user journey to better accomplish their specific goals. This task becomes even more challenging when dealing with limited character counts, so selecting the most effective words becomes essential.

Having a foundational framework that includes

124. Hernández, Eleazar. 2017. "The Art of Copywriting." In Leading Creative Teams: Management Career Paths for Designers, Developers, and Copywriters, edited by Eleazar Hernández, 129–39. Berkeley, CA: Apress.

error messages, success and confirmation messages, tooltips, and calls to action is essential for achieving this goal.

Visibility of system status[125], exemplifies a usability heuristic that emphasizes the importance of communication and transparency in acknowledging the system's current state. By doing so, users are empowered to maintain a sense of control, take necessary actions to achieve their objectives, and ultimately develop trust in the brand.

This *conversational* aspect of timely feedback is amplified by verbal language and sublimed by experience.

6.4. MARKET

Here, a simple assumption is made based on a targeted communication model: This system reaches mass audiences and receives feedback from the real world. A feedback loop is created between sender and receiver.

So, this assumption of a targeted communication model for the GDS is a crucial aspect of the system's success. This model enables the system to reach mass audiences and receive feedback from the real world, creating a feedback loop between sender and receiver. As a result, communication is optimized, and the system becomes more focused on specific information sharing and updating.

One of the key advantages of this targeted communication model is that it enables all subsystems within the GDS to

125. Experience, World Leaders in Research-Based User. n.d. "Visibility of System Status." Nielsen Norman Group

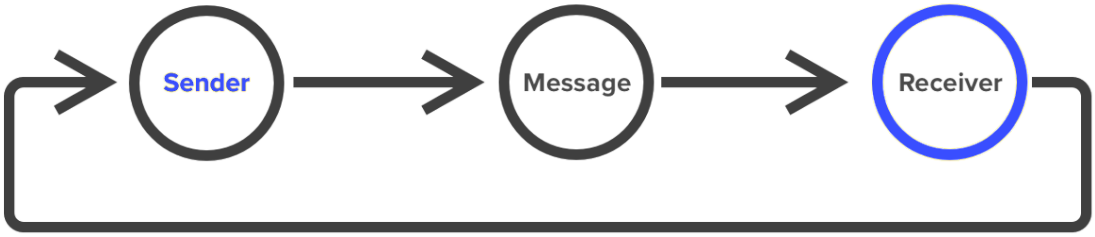


Figure 34.

Circular
Communication Model

receive and apply information from such feedback loops. This means that the end-users can participate in the application of this feedback and co-produce alongside internal contributors. This co-production approach is particularly effective because it enables the system to leverage the collective knowledge and expertise of both internal and external stakeholders.[126]

By incorporating feedback loops into the design process, the Global Design System can ensure that it remains responsive and adaptive to the evolving needs of its target audience. This approach can also help the system to identify and address any issues or challenges that arise during the design process.

The figure above represents this communication model of moving the end-user from *spectator* to *participant*.

This model can also be seen as a *blueprint* to move from evolution to revolution.

6.4.1. MARKET PRINCIPLES

Given the existing development streams — Interactive, Visual, and Voice — it is crucial to deploy a Market development stream that adheres to principles that complement and enhance these streams. The following section of information depicts a possible approach to this challenge.

6.4.2. PRINCIPLES

Targeted: Focus on reaching the specific audience that will

126. Almirall, Esteve, Melissa Lee, and Jonathan Wareham. 2012. "Mapping Living Labs in the Landscape of Innovation Methodologies." Technology Innovation Management Review, no. September 2012: Living Labs: 12–18.

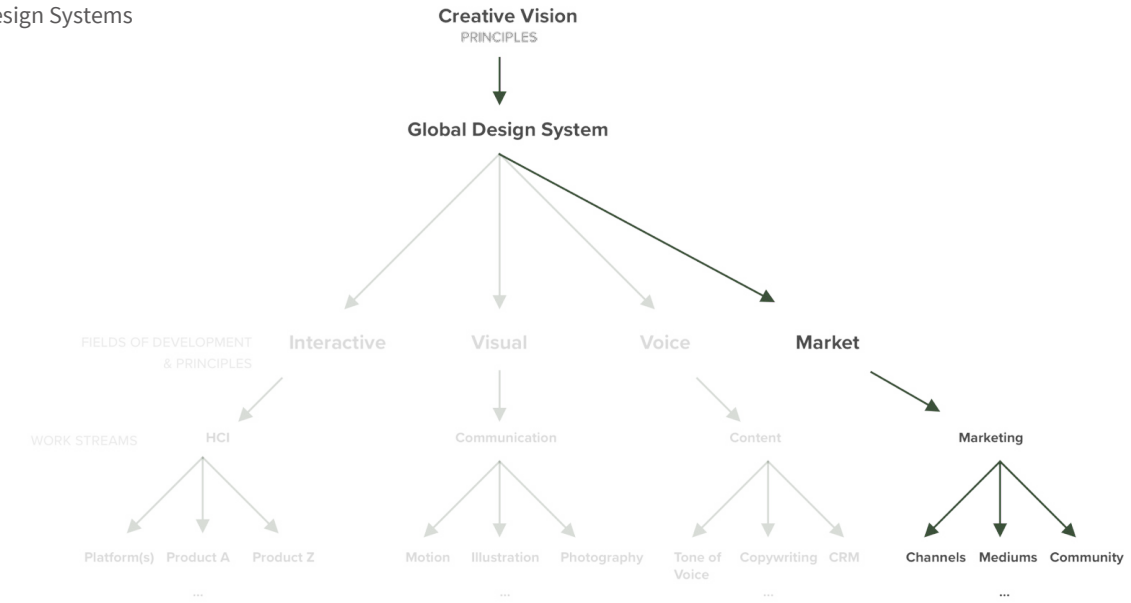


Figure 35.

Market Subsystem Stream

benefit from and engage with the design system.

Integrated: Ensure alignment with the Interactive, Visual, and Voice streams, maintaining consistency across all touch points.

Adaptive: Embrace change and be responsive to market dynamics and user feedback.

Engaging: Foster interaction and engagement through captivating content and channels.

Impactful: Focus on delivering measurable results that contribute to the success of End-User goals and the Global Design System.

The fact that this is an independent stream of work, under the light of GDS, provides every contributor involved with a degree of independence to arrive at specific conclusions about this workstream foundation level. Therefore, it's fundamental to constantly check and fetch information from all subsystems represented in Figure 34, below.

6.4.3. CHANNELS & STRATEGIES

Without the purpose of not diving into much detail, but rather informing briefly this text, we'll cover some possible approaches about communication channels and strategies.

1. **Digital Media Channels**: Leverage social media platforms, such as Facebook, Instagram, Twitter, and LinkedIn, Reddit, to share engaging content and interact with users. Utilize content marketing through blog posts, webinars, and podcasts,

People are inherently social and look to create and maintain relations not only with other people, but also with brands[130]

to educate and engage the audience.[127]

2. **Alternative Channels**: Utilize experiential marketing events, such as workshops, conferences, and immersive installations, to offer hands-on experiences with the design system.[128] Collaborate with influencers or experts in the design field to enhance credibility and reach a wider audience.
3. **Guerrilla Marketing Strategies**: Employ unconventional marketing tactics to create buzz and increase visibility. For example, leverage street art or pop-up installations in high-traffic urban areas, initiate flash mobs, or create an interactive public art piece that encourages social media sharing.[129]

127. Pulizzi, Joe. 2012. "The Rise of Storytelling as the New Marketing." Publishing Research Quarterly 28 (2): 116–23.
128. Schmitt, Bernd. 2010. "Experiential Marketing." Journal of Marketing Management, February. 15(1-3), 53-67.
129. Levinson, Jay Conrad. 2006. Guerrilla Marketing: Put Your Advertising on Steroids. Garden City, NY: Morgan James Publishing.
130. Ashley, Christy, and Tracy Tuten. 2015. "Creative Strategies in Social Media Marketing: An Exploratory Study of Branded Social Content and Consumer Engagement: Creative Strategies In Social Media." Psychology & Marketing 32 (1): 15–27.

7. DESIGN MACHINES

7.1. CREATIVITY

In this chapter, we explore the digital echo chamber effect and its impact on creative work, particularly in the context of generating homogeneity instead of diversity in output. The echo chamber effect refers to the situation where individuals are only exposed to information that confirms their existing beliefs or opinions, leading to a narrowing of perspectives and ideas.[131] This effect is particularly prevalent in digital environments, where social media algorithms and search engine personalization contribute to the formation of "filter bubbles".[132]

Moreover, the digital nature of most development tools, coupled with the emphasis on speed and efficiency in the creative process, can inadvertently amplify creative loops and dead ends. While digital tools offer numerous advantages, such as increased accessibility, collaboration, and ease of use, they can also inadvertently contribute to the echo chamber effect, limiting exposure to diverse perspectives and ideas.[133]

Digital tools often streamline and automate various aspects of the creative process, allowing creators to work faster and iterate more frequently. However, this increased velocity can also lead to rapid convergence on familiar, pre-existing solutions rather than fostering exploration of novel and innovative ideas.

To counteract these potential pitfalls, it is essential for creators to be aware of the limitations of digital tools and actively seek

131. Sunstein, Cass R. 2017. #Republic: Divided Democracy in the Age of Social Media. Princeton ; Oxford: Princeton University Press.

132. Pariser, Eli. 2012. The Filter Bubble.

133. Li, Jian. 2019. "Globalization, Global Education, and Chinese Global Education: Efforts and Concerns." In Global Higher Education Shared Communities: Efforts and Concerns from Key Universities in China, edited by Jian Li, 3–22. Perspectives on Rethinking and Reforming Education.

diverse sources of inspiration and knowledge beyond their digital echo chambers. This may involve embracing analog methods, interdisciplinary collaboration, and real-world experiences to broaden perspectives and facilitate the development of innovative, heterogeneous creative work.[134]

Considering the potential negative impact of digital echo chambers on creative work, as highlighted in studies by Lehrer[135] and Gaggioli et al.,[136] we propose a hypothesis that suggests simple heuristics or algorithms for generating new sources of stimuli outside digital mediums. These heuristics aim to promote diversity and break the cycle of homogeneity in creative outputs and outcomes.

Hypothesis: The introduction of simple heuristics or algorithms that encourage exposure to diverse, non-digital *stimuli* can counter the echo chamber effect, resulting in more heterogeneous creative work.

To address this hypothesis, we recommend the following heuristics:

Serendipitous encounters: Regularly explore new physical spaces (e.g., museums, galleries, nature trails) or attend cultural events (e.g., concerts, workshops, lectures) to encourage exposure to unexpected sources of inspiration.

Interdisciplinary collaboration: Collaborate with individuals from different disciplines or backgrounds to

134. Csikszentmihalyi, Mihaly. 2013. Creativity: Flow and the Psychology of Discovery and Invention. Reprint edition. New York: Harper Perennial.

135. Lehrer, Jonah. 2012. Imagine: How Creativity Works. 1st edition. Houghton Mifflin.

136. Gaggioli, Andrea, Alice Chirico, Elvis Mazzoni, Luca Milani, and Giuseppe Riva. 2017. "Networked Flow in Musical Bands." Psychology of Music 45 (2): 283–97.

"Creative problem solving is defined as the process by which the agent discovers new concepts that were not in the initial conceptual space of the agent, allowing it to accomplish a previously impossible goal."[137]

foster a cross-pollination of ideas and perspectives.

Analog information consumption: Allocate time for reading books, magazines, or newspapers in print format to expand knowledge and gain exposure to a wider range of topics outside of digital content personalization algorithms.

Deliberate diversity: Make a conscious effort to engage with individuals holding different opinions or beliefs, and seek out content or experiences that challenge personal preferences or comfort zones.

Reflection and mindfulness: Dedicate time for self-reflection and mindfulness practices, which can help individuals become more aware of their own biases and thought patterns, opening the door to new perspectives and ideas. Seek and delve into natural spaces, outdoors, closer to nature and further away from screens.

In the study "Parametric design strategies for the generation of creative designs"[138] by JuHyun Lee et al., the authors explore the potential of parametric design in fostering creative design solutions. Parametric design, an approach that utilizes algorithmic and computational techniques to manipulate design parameters, allows designers to explore a vast design space efficiently. By employing various strategies, such as abstraction, variation, and integration, parametric design can help generate innovative and unique design outcomes, pushing the boundaries of conventional

137. Gizzi, Evana, Lakshmi Nair, Jivko Sinapov, and Sonia Chernova. n.d. "From Computational Creativity to Creative Problem Solving Agents." P.371

138. Lee, JuHyun, Ning Gu, and Anthony P. Williams. 2014. "Parametric Design Strategies for the Generation of Creative Designs." International Journal of Architectural Computing 12 (3): 263–82.

7.2. PERSPECTIVES

The creative act extends beyond just inspiration or genius; it encompasses the development of devices and mechanisms for recursive generation, promoting a continuous construction and access to diverse ideas and perspectives. This view suggests that creativity thrives on the transformation and manipulation of raw materials, transcending static and unidimensional perspectives.

Additionally, a truly meaningful creative act often begins with the physical manipulation of tangible or intangible materials, allowing creators to explore and experiment with various states and possibilities. Through the process of modeling a physical medium or artifact, a designer is able to generate more potential state alterations, resulting in unexpected and valuable outcomes. These outcomes can then be translated or adapted to other mediums, ultimately enriching the overall creative process and fostering innovation.

This hypothesis is briefly addressed in the paper "Design Machines."[139] for class ‘Digital Culture'.

7.3. ADJACENT POSSIBLE

Creativity is a complex and multifaceted phenomenon that benefits from various techniques and approaches. One such technique is the concept of the *adjacent possible*, which was introduced by Stuart Kauffman[140]

139. Melo, Rodrigo. 2022. "Design Machines."

140. Björneborn, Lennart. 2020. "Adjacent Possible." In The Palgrave Encyclopedia of the Possible, 1–12.

and later popularized by Steven Johnson.[141] The adjacent possible represents the space of potential ideas and innovations that are one step away from our current understanding, allowing us to make connections between seemingly unrelated concepts or fields.

When exploring creativity and the adjacent possible, it is essential to focus on three key aspects: focus, relationships, and energy.

Focus: To effectively harness the power of the adjacent possible, it is crucial to maintain a balance between exploring new ideas and refining existing ones. By staying focused and attentive to new developments and trends, creative individuals can identify opportunities for innovation that may have been overlooked by others.

Relationships: Building connections and fostering relationships with people from diverse backgrounds and fields can facilitate the exchange of ideas, leading to creative breakthroughs. By engaging in interdisciplinary collaboration, creative individuals can access a broader range of perspectives and experiences, enhancing their ability to develop novel and innovative solutions.

Energy: Creativity requires energy and commitment, as it often involves experimenting with new ideas, iterating on prototypes, and overcoming obstacles. By cultivating a sense of curiosity and enthusiasm, creative individuals can maintain the energy required to navigate the complex landscape

141. Johnson, Steven. 2011. Where Good Ideas Come From: The Natural History of Innovation. Reprint edition. New York: Riverhead Books.

of the adjacent possible and bring their innovative ideas to fruition.

By embracing techniques such as the *adjacent possible* and focusing on these key aspects, individuals and organizations can foster an environment that supports creative thinking and innovation, ultimately leading to the development of groundbreaking ideas and solutions.

7.4. FLUID BOUNDARIES

The dynamics that underlie and uphold Global Design Systems involve also expanding the idea of adjacent possibilities beyond rigid boundaries or fixed domains. These should be seen as *fluid boundaries*. By embracing a more fluid and dynamic approach to adjacent possibilities, designers and innovators can explore new and unexpected connections between seemingly disparate areas of knowledge or fields of inquiry. Pushing forward the notion of networked creativity that is propelled by GDSs, one can leverage the power of networked communities and open innovation to create more diverse and collaborative possibilities. By connecting with others who share similar interests but with different areas of expertise, designers and innovators can draw upon a broader range of perspectives and knowledge.

One can also approach a sense of radical collaboration, through metadesign, embracing a more collaborative and co-

creative approach to adjacent possibilities. By working closely with stakeholders and end-users, designers can create solutions that are more closely aligned with user needs and preferences, leading to desired and yet unexpected outcomes.

7.5. ENTANGLEMENT

The concept of the adjacent possible, which emphasizes exploring untapped potential and making connections between seemingly unrelated concepts or fields, naturally segues into Neri Oxman's vision of the *Age of Entanglement*.[142]

In this new era of design, characterized by the intertwining of the natural and artificial, it is the very act of tapping into the adjacent possible that fuels innovation. By fostering interdisciplinary collaboration and combining insights from biology, material science, and computation, designers can create sustainable, adaptive, and groundbreaking solutions inspired by nature's complexity and interconnectedness. This holistic approach to design demonstrates the power of the adjacent possible to transform our understanding of the relationship between form, material, and function, ultimately shaping the future of design and innovation.

142. Oxman, Neri. 2016. "Age of Entanglement." Journal of Design and Science

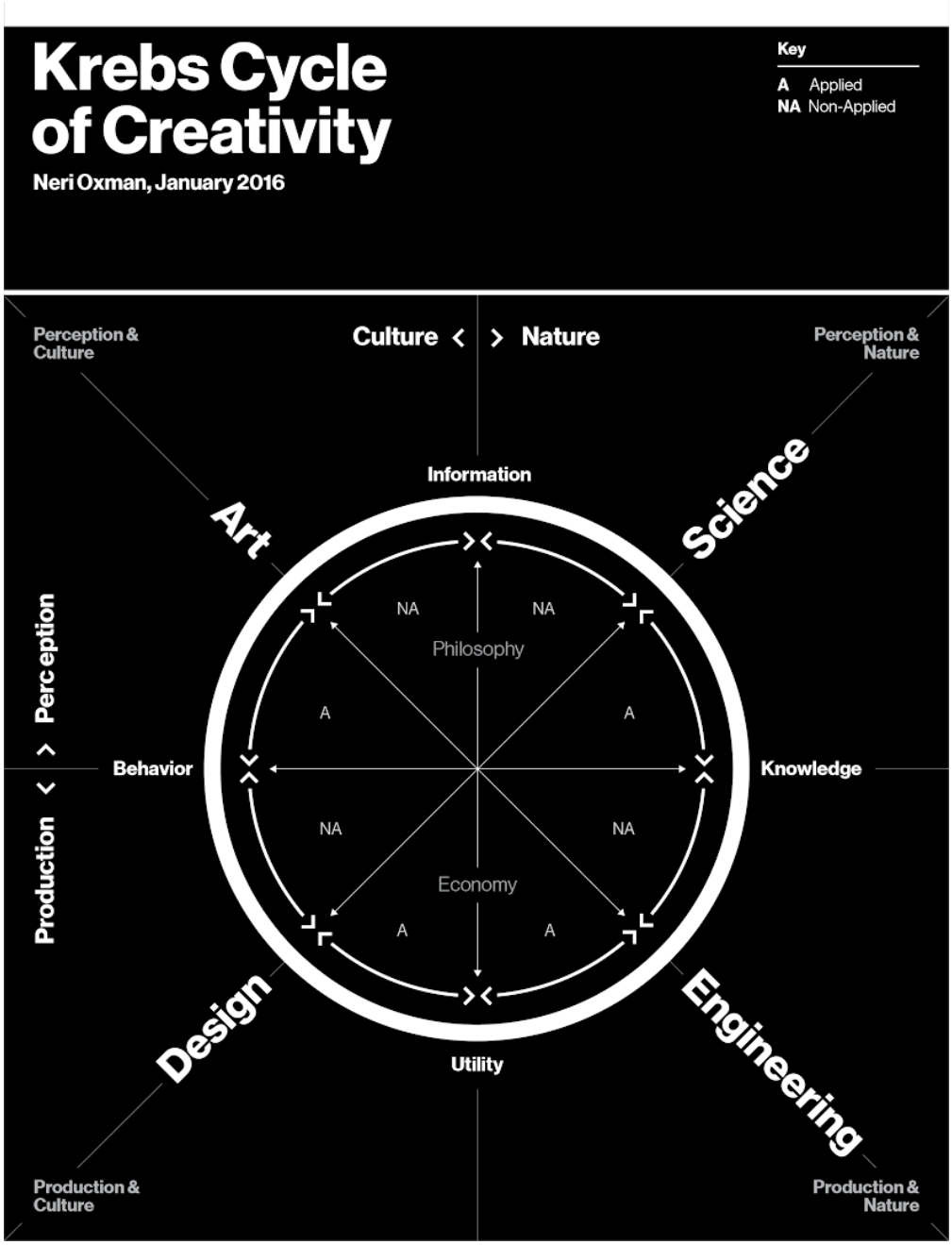


Figure 36.

Krebs Cycle of Creativity by Neri Oxman[143]

"The role of Science is to explain and predict the world around us; it 'converts' information into knowledge. The role of Engineering is to apply scientific knowledge to the development of solutions for empirical problems; it 'converts' knowledge into utility. The role of Design is to produce embodiments of solutions that maximize function and augment human experience; it 'converts' utility into behavior. The role of Art is to question human behavior and create awareness of the world around us; it 'converts' behavior into new perceptions of information, re-presenting the data that initiated the KCC in Science. At this 'Cinderella moment' — when the hands of the KCC strike midnight — new perception inspires new scientific exploration. For example, in As Slow as Possible, John Cage transports the listener into a state where space and time are stretched, offering a personal interpretation of time dilation and questioning the nature of space-time itself."[144]

— Neri Oxman

143. Ibid

144. in Yeo, Darren. 2023. "Circling Back on Design and Everything Else." Medium. March 20, 2023

8. SPACESHIP.COM - CASE STUDY[145]

"We want to create a smart and powerful new platform that allows any customer to find, purchase, connect and manage digital products in a new and completely seamless way. We will empower our customers to get online easily and quickly by managing the inherent complexities that are usually associated with digital products. Things like setting up dns, managing subscriptions, not being able to easily switch between products and add-ons are only some of the core issues our customers face today. Through our smart use of technology we will solve these problems by managing the complexities in the background and we will match those solutions to an intuitive design and world class user experience to effectively simplify the entire customer journey and flow. This new platform will be at the forefront of connecting our customers to any digital product by bringing them together in a way that almost anyone can understand and in the process will re-define what seamless means within our industry and beyond."[146]
— Richard Kinkerdall

Let's look at this challenge, by taking the golden circle approach depicted in Figure 24.

8.1. THE WHY

To initiate all processes involving deciding to invest money and time, as well as a lot of human resources in a business or project, a clear executive vision is required.

From the example statement, a simple exercise is performed to extract keywords that will provide further guidance to strategy:

- **Connect**, people (and their ideas) with digital products
- **Get Online**, create a presence online easily and without the inherent complexities that are usually associated with digital products
- **Seamless**, easy to find, purchase, connect and manage digital products
- **Re-define**, give a new meaning to what seamless means within our industry and beyond.
- **Platform**, our main touchpoint with people online
- **Empower**, people to materialize their ideas
- **Privacy**, security means trust

These keywords are at the foundation of everything that should come next and defines the brand Spaceship.[147] This strategy triggers multiple streams of work, where we'll be focusing on Design first and foremost but with a clear and intended parity with engineering.

The concept of a new platform and therefore a new

145. The artifacts presented in these next chapters have the Copyright of Spaceship, Inc — copyright © 2019–2023 spaceship.com. These are the results of multiple contributors and teams from multiple disciplines and cultures.

146. Kinkerdall, Richard, 2018 Namecheap, Inc CEO

147. Spaceship, Inc — copyright © 2019 –2023 spaceship.com

technology(ies) is paramount and is seen with great enthusiasm, but for the interest of this text we'll focus more critically in the understating and identification of fundamental requirements for the teams involved, from design and engineering, to c-level teams or stakeholder(s), customer service or any operational team, in creating and making possible such an approach. For this to be feasible it's fundamental to create a shared language and shared understanding of each other's perspectives and capabilities. This feasibility and methodologies, to achieve the desired outcomes are related to the core value proposition of this text

8.2. FOUNDATIONS

8.2.1. BRAND OVERVIEW

The Spaceship mark is inspired by our day to day graphical user interface mouse cursor. This is the *vehicle* that takes us anywhere online. A *medium* that takes us anywhere.

This same cursor enables us to explore the internet through hypertext and hyperlinks, amplifying our physical life, taking us to unexpected and unknown digital places. The way we explore these digital spaces is different from the real world. Digital space exploration is not sequential or even logical all the time, meaning that with one click I can suddenly be very far away from one specific written and visual context to be found elsewhere e.g.

hyperlink click from one cooking website to wikipedia website. We build meaning from these non-sequential results (pages), outputs of these sequential actions (clicks).

Further visual reference can be found going back to a 1981 research paper[148] published by Xerox, where the mouse, and therefore the mouse cursor, was invented by Douglas Engelbart, and was initially an arrow pointing up.

When the XEROX PARC machine was built, the cursor changed into a tilted arrow. It was found that, given the low resolution of the screens in those days, drawing a line in a 45 degree angle was easier to do and more recognizable than a straight one.

Considerations:

- Through hypertext and hyperlinks users explore and navigate our brand and channels in a way that is not necessarily sequential or even logical.
- The goal is to bring clarity to what our products and services are and do.
- Spaceship connects all these different moments and products and leaves space for the customer to build on the possibilities they present.
- The user should feel safe, even through such complexity we're guiding him to the exact place to click in the right option.
- Spaceship is a next gen tech platform: *Sophisticated*, *Futuristic* and *Universal*.

148. Wadlow, T. 2011. "The Xerox Alto Computer, September 1981, BYTE Magazine."

8.3. DESIGN LANGUAGE

8.3.1. VISUAL COMMUNICATION SUB-SYSTEM

While it may be expected to have a linear development of such systemic communication frameworks, the fact is, in this case study, this development is nonlinear. So, the Visual Sub-System depicted in Figure 19, was not triggered in its entirety at a foundational level before the Human Computer Interaction Sub-System. The only foundational tokens known at the initial phases were the symbol, logotype, color and typography. These design primitives were enough to trigger, in parallel, the HCIS workstreams depicted in Figure 10.

These two subsystems are at the core of this design language, constantly injecting information into each other, in an asynchronous and non-linear fashion.

The following sections of development of a visual identity tackle in more detail what are the design tokens and guidelines that create enough critical mass to build a non-agnostic HCIS in this case study.

8.3.2. DESIGN PRINCIPLES

Every new creation, no matter its nature or complexity, must always adhere to following visual design principles.

While the previous statement may not be an absolute axiom, following the principles that will be covered next, acts as a mindset bootstrap for the creatives

involved and generally leads to more effective communication and improved results. It is worth noting that while adhering to these principles is generally beneficial, there is room for creative experimentation and deviation, depending on the context and objectives of a particular design project. The best contributors know how to strike a balance between adhering to these principles and breaking the rules when it serves the design's purpose.

With this said, the purpose is to start the creative workflow removing the unnecessary and focusing on a clear direction, not by creating dogmatic or strict rules but by inspiring a refreshed assessment of one's beliefs and individual, singular perspectives of what the following principles mean and how to set them into practice.

Striving to achieve diversity rather than homogeneity or *flat* consistency, is also part of this creative direction.

A reference that supports the importance of visual design principles can be found in the work of Ellen Lupton & J.C. Phillips, Graphic design: The new basics.[149]

8.3.2.1. UNIVERSAL & TIMELESS

Spaceship communication should resonate with a global audience, irrespective of gender, age, culture, or location. A creation must be timeless and relevant both today and in the future. It is recommended to steer clear of obvious and figurative representations and instead

149. Lupton et al. Graphic Design: The New Basics

concentrate on the message's essence to avoid a literal or clichéd approach.

Future proof suggests that a successful design or creation should have qualities that make it both enduring and relevant, regardless of changes in time, context, or technology.

To create something that is timeless, designers may look to incorporate elements that are classic, simple, and enduring, rather than relying on trends or fads that may quickly become outdated or simply common places.

Here, the approach is to design foundations that are layered through propositions of flexibility, modularity and iteration. So, rather than striving for perfection, the goal is to donate a sense of permanent adaptation and evolution from the core structure of creation. Therefore, the contribution of each new generation of creatives can be incremented, transforming and even proposing revolution to initial assumptions.

With this said, most visual formalisations expressed in this work, may be different or evolved in the mid/long term. This should be seen as a highly mutable and transient formalization of design.

8.3.2.2. PHYSICAL & NON PHYSICAL

Imagination knows no bounds, and thus, one should explore and blend various worlds,break free from the obvious and welcome

Correct and effective brand association includes favorable, strong, and unique associations. Factors that constitute brand association include perceived value, brand personality, and organizational association.[150]

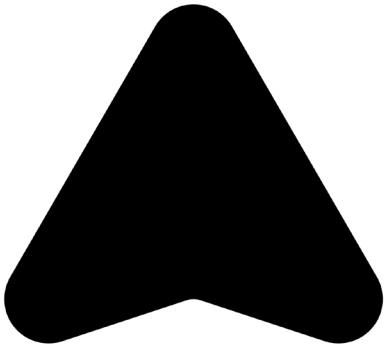
inspiration in all its forms. The digital and material worlds offer a universe of ideas; bring them together in innovative and imaginative ways that surprise and delight.

8.3.2.3. PURE & SIMPLE

Simplicity is the path to sophistication. Embrace the power of purity by eliminating noise and clutter to reveal the true essence of things. This does not imply creating soulless or empty visuals. Instead, it involves transcending complexity through pure and simple beauty, which is crucial in a world dominated by complicated software and technology.

Figure 37.

Spaceship Glyph



8.3.3. SYMBOL

The Spaceship symbol is built from an equilateral triangle, lapped by circumferences proportional to the size of the triangle.

8.3.4. COLOR

Color is one of the most important elements in a brand identity. It distinguishes a brand and helps to create consistent communication experiences. While there's a primary brand color, Spaceship Blue (SPS Blue), there are secondary colors, Spaceship Dark Grey and White .

In 2016, designer Paul Hebert did an analysis[151] of the ten most popular sites on the internet, according to Alexa.com, and scraped data about the colors they were using. The color blue

150. Jin, ChangHyun, MoonSun Yoon, and JungYong Lee. 2019. "The Influence of Brand Color Identity on Brand Association and Loyalty." Journal of Product & Brand Management 28 (1): 50–62.
151. Herbert, Paul "The Colors of the Web."

" One of the central elements of HTML is the hypertext link as ‘the basic hypertext construct' enabling connections between different resources on the web (W3C, n.d.). Hypertext links, commonly referred to as hyperlinks, web links, or just simply links, allow the creation of interconnections between websites, web pages, and other web objects. As such, they bear the capacity to weave disparate entities of the web together into ‘a single, global information space', which Berners-Lee called the World Wide Web"[153]

is well ahead in the rendered charts. In a 1993 screenshot[152] of his WorldWideWeb browser, Tim Berners-Lee himself had the hyperlinks in blue.

In fact, adding this blue-colored and underlined text to hyperlinks is considered a milestone in the popularization of graphical browser standards according to the World Wide Web Consortium (W3C). This convention was established in the early days of the web and is now widely recognized and used across the internet.

The first graphical web browser, called Mosaic[154], released in 1993, used blue text to indicate hyperlinks. This convention was then adopted by other web browsers, such as Netscape Navigator[155] and Internet Explorer.[156]

As stated in the book *Web Style Guide* by Patrick Lynch and Sarah Horton, "the blue underlined hyperlink became the ubiquitous standard" and "this graphic feature, perhaps more than any other, distinguished the Web from other electronic media."[157]

Furthermore, the choice of this particular color to the context of the present design challenge, implies adding attributes such as a sense of tranquility or peacefulness, and fostering inventiveness and ingenuity. A more exhaustive collection of attributes and associations can be discovered in the research conducted by ChangHyun Jin et al. briefly depicted in Figure 34.

152. "Tim Berners-Lee's Original WorldWideWeb Browser in 1993."
153. Brügger, Niels, and Ian Milligan. 2018. The SAGE Handbook of Web History. SAGE. P. 230
154. "Mosaic Launches an Internet Revolution." n.d. NSF - National Science Foundation. Accessed April 24, 2023.
155. "Netscape Navigator - MDN Web Docs Glossary: Definitions of Web-Related Terms | MDN." 2023. February 21, 2023.
156. "Internet Explorer (IE) | Browser, Downloads, Versions, & Facts | Britannica." 2023. March 20, 2023.
157. Lynch, Patrick J., Sarah Horton, and Ethan Marcotte. 2016. Web Style Guide, 4th Edition: Foundations of User Experience Design. Fourth edition. New Haven: Yale University Press. P.32

Color	Attributes and associations
Blue	Lovers, freedom, transparency, hope, juvenescence, youth, deep roots, clowns, the past, admiration, silence, stillness, bravery, thrilling, lonely, fatigue, rationality, quietness, cleanness, justice, progress, sadness, fresh flavors, smart

Figure 38.

Blue Color association and symbolism[158]

158. Jin, ChangHyun, MoonSun Yoon, and JungYong Lee. 2019. "The Influence of Brand Color Identity on Brand Association and Loyalty." Journal of Product & Brand Management 28 (1): 50–62.

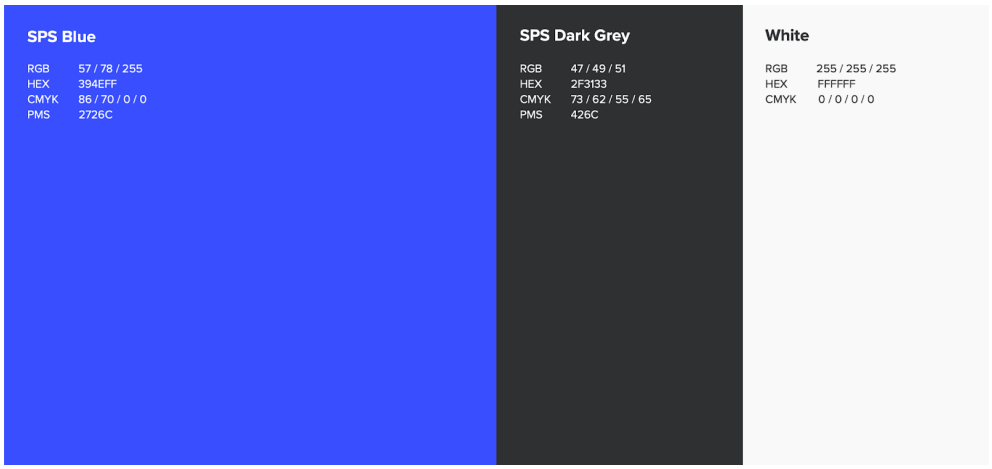


Figure 39.

Primary, secondary and tertiary colors

The auxiliary palette serves to further enhance the brand's personality by providing corresponding tones in close proximity to the SPS Blue, thus expanding the color range in both the cold and warm sides of the spectrum. This reinforces the feeling of harmony between all colors, including the foundational colors of the brand. The auxiliary color palette is a vital tool for addressing various communication needs of the brand, such as creating visual assets, corporate materials, merchandising, and more. The color system is built to have a base color with matching shade (darker) and tint (lighter) variations.

Figure 40.

Auxiliary pallete

Figure 41.

Color System Scales

8.3.5. TYPOGRAPHY

Gotham Rounded is a technical letter that goes from friendly to high-tech to cheeky with ease.

Designed by Tobias Frere-Jones and released by Hoefler & Co.,[159] the Gotham typeface is available in two styles and four weights, and captures the unembellished yet intricate lettering of engineering. This lettering is typically seen on precision instruments, blueprints, stencils, and templates, and is rendered through methods such as drawing, stamping, engraving, and routing. The inspiration for this font comes from the monumental signs on buildings that celebrate the straightforward and functional alphabet of a skilled draftsman.

Figure 42.

Typeface

159. "Gotham Rounded Fonts - How to Use." n.d. Accessed March 12, 2023.

Figure 43.

Typeface weights

These fundamental attributes are directly embedded in a highly technical environment but yet powerfully simple rendering of the mark, being both light and highly legible. The rounded edges blend perfectly with the symbol.

This typography is only used in the creation of visual identities for logotypes in Master and Sub brands only.

Another typography acts as the primary font for all written content and typographic base token for the HCIS, which we'll approach soon. The different necessities of communication are at the base of this decision and strategic approach.

8.3.6. WORDMARK

Technical, confident and practical. This formal solution enables communication in a friendly and conversational tone with a universal audience. The use of a sans-serif font is intentional, as it is easily readable and

Figure 44.

Wordmark

spaceship

Figure 45.

Logotype — Horizontal Lockup

accessible to people of all ages and backgrounds. Lowercase letters are intentionally used to convey a sense of approachability and informality.

Design principles, such as simplicity and universality are then evoked adding attributes of a conversational and welcoming design language to all audiences, and denoting a sense of accessibility and inclusivity, as it removes the barrier of formality that can sometimes be associated with uppercase letters. The lowercase letters also create a more balanced and harmonious visual appearance when paired with a bold glyph or symbol.

8.3.7. THE LOGOTYPE

8.3.7.1. HORIZONTAL LOCKUP

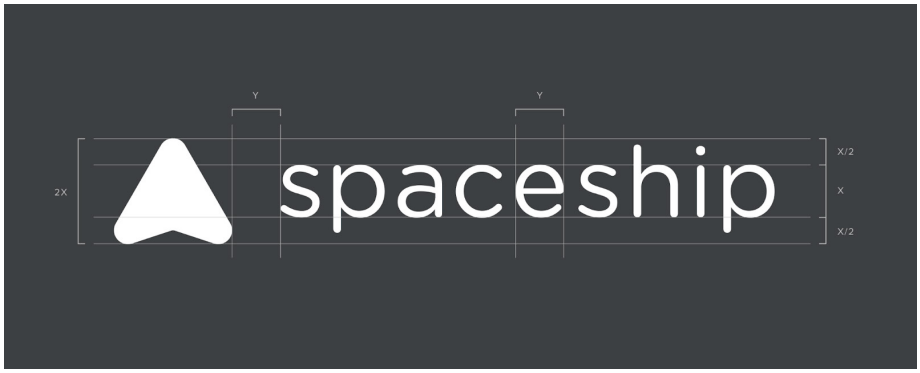


Figure 46.

Horizontal construction grid

8.3.7.2. VERTICAL LOCKUP

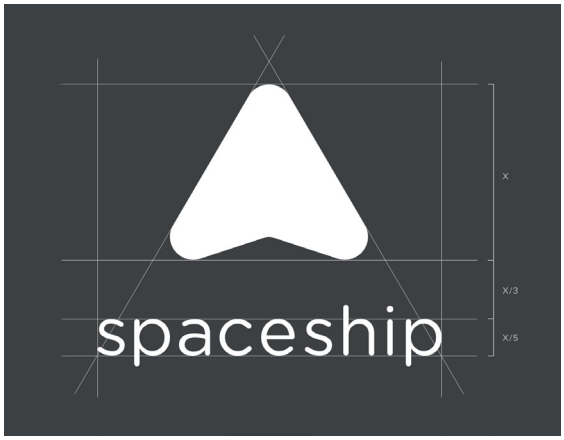


Figure 47.

Vertical construction grid

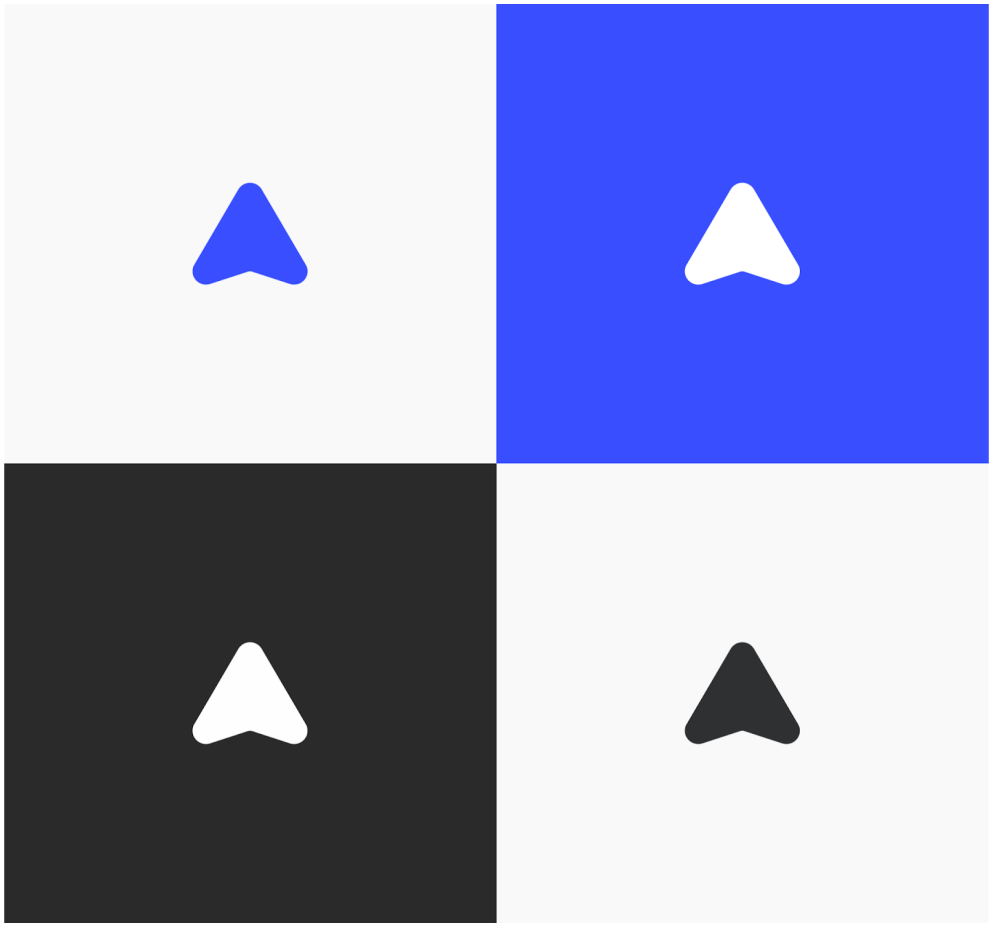


Figure 48.

Color and high contrast

8.3.8. VERSIONS

The logo versions are divided into two categories: color and high contrast. The color versions use the main brand colors, this way we can communicate the brand look and feel. For that reason, they are the ideal ones to use. The high contrast versions are used whenever there is low background clarity and out of the brand context.

8.3.9. SAFE SPACE

8.3.9.1. SYMBOL

The safe space margin ensures the legibility and impact of the logo. The minimum space is equal to 1/2 symbol height and width. Give the logo more clear space whenever possible.

The logo is designed to scale to small sizes on-screen and print,

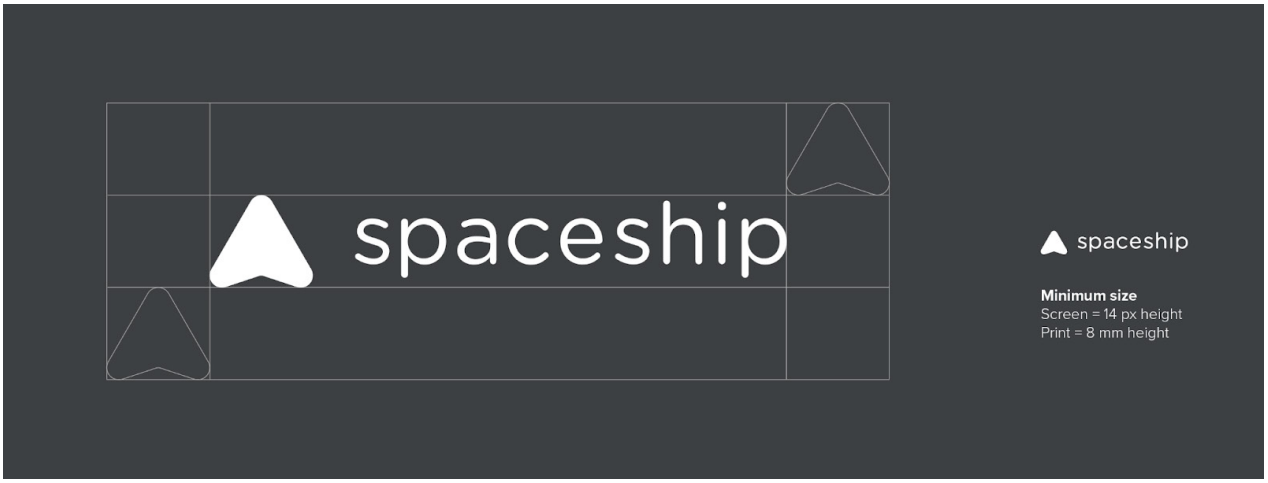
Figure 49.

Safe space - Glyph

while keeping its readability. The placement depends on the type of communication and its specific limitations (i.e. icons, signage, merchandising).

Figure 50.

Safe space - horizontal lockup



8.3.9.2. HORIZONTAL LOCKUP

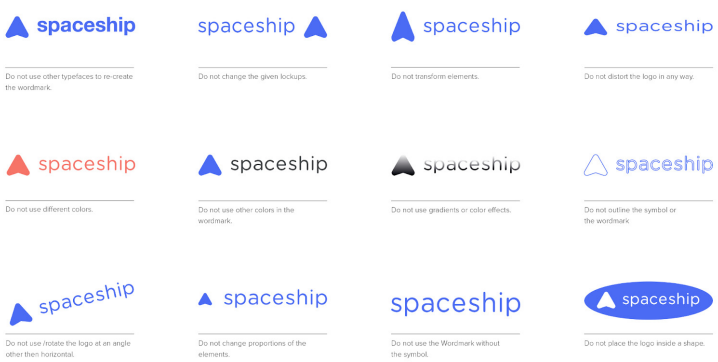
guidelines to ensure that it is presented effectively and consistently across various applications. Also, it's fundamental to approach these guidelines visually with Dos and Don'ts. In the following image we'll see an example of Don'ts.

8.3.10. GUIDANCE

When using the logotype, it is essential to follow certain

Figure 51.

Guidance



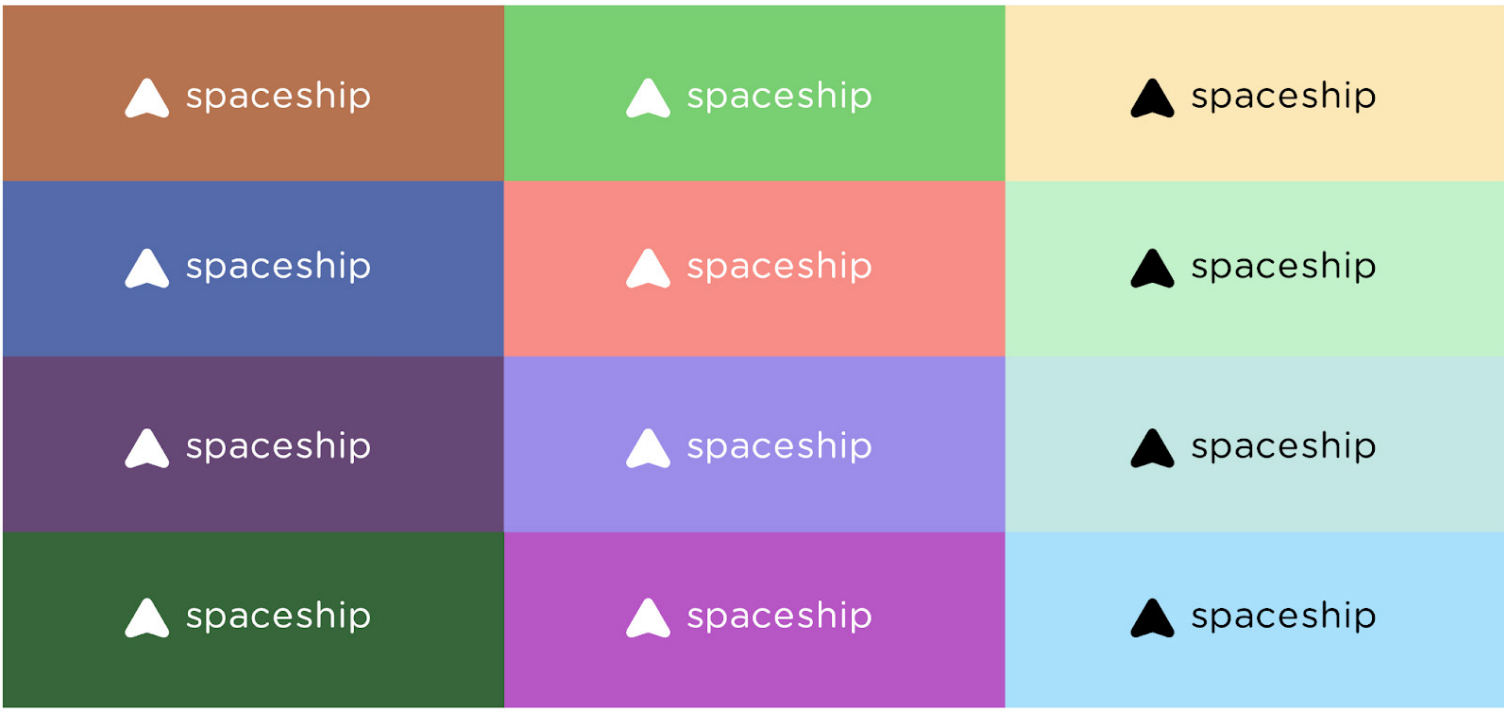


Figure 52.

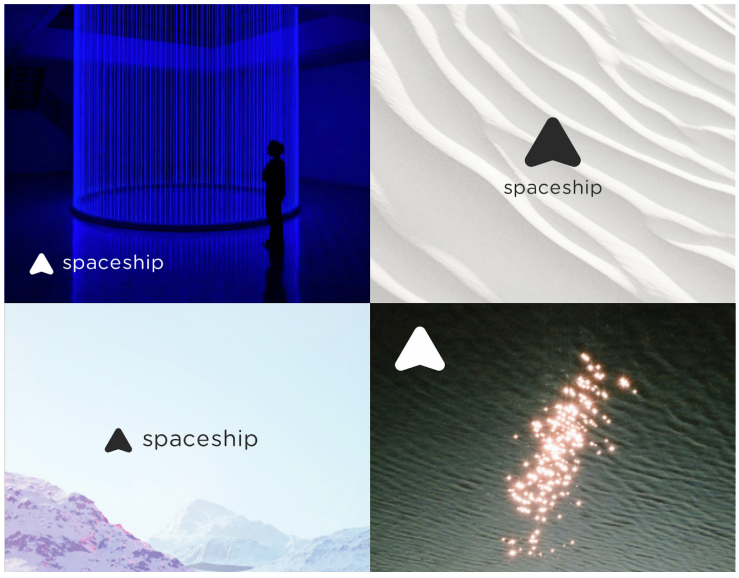
Background behavior

8.3.11. COLOR BACKGROUND BEHAVIOR

To ensure that the logo remains legible against solid color backgrounds, it is advisable to use the black or white version when the background has low contrast applied to white or black. Alternatively, the white or black versions of the logo should be used based on the tone and contrast of the background.

Figure 53.

Photographic Background behavior



8.3.12. PHOTOGRAPHIC BACKGROUND BEHAVIOR

To ensure legibility across various photographic backgrounds, the logo must be composed with clarity in mind. It is recommended to use black or white (high contrast) version of the logo and position it in areas with minimal visual distractions.

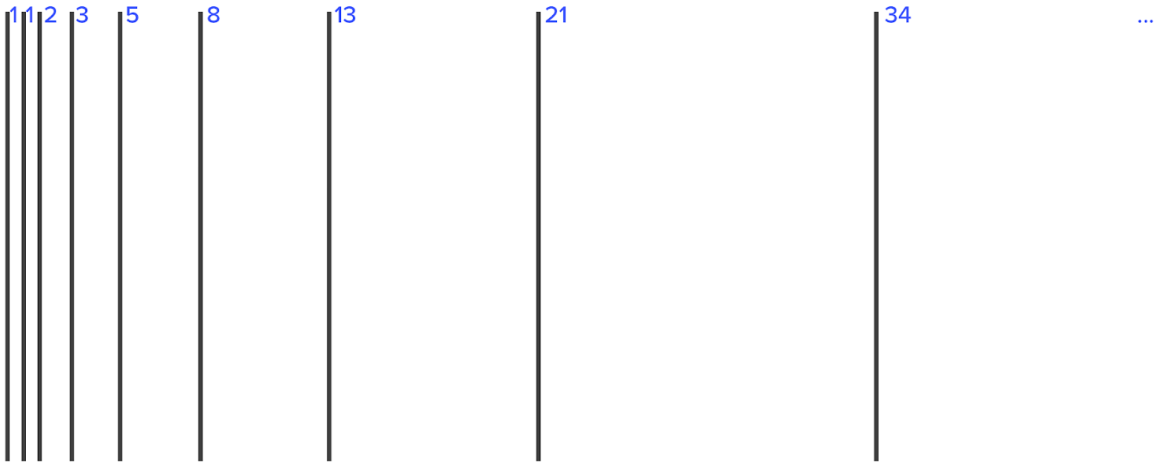


Figure 54.

Fibonacci sequence in composition

Depending on the tone and contrast of the background, either the white or black logo version can be used.

8.3.13. COMPOSITION

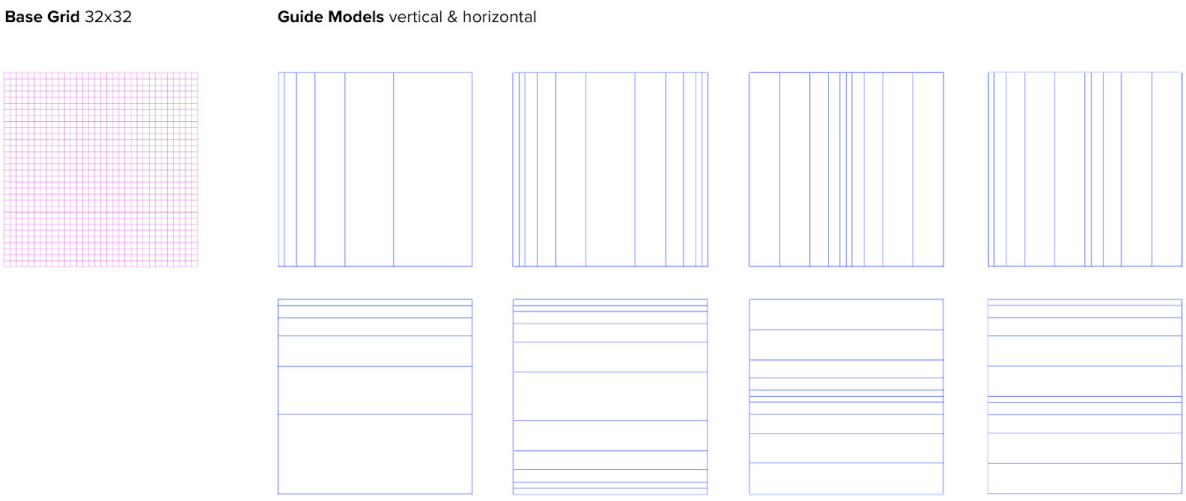
A universal concept regarding composition was established, a simple logic that can be translated into visual elements. The attributes found in the Golden Ratio - Fibonacci sequence.

This sequence starts in 0, 1, 1, 2, 3, 5, 8, 13, 21… It's also called the golden section, golden mean, or divine proportion, which is a mathematical relationship that surfaces from the sequence briefly approached before, that yields the number 1.618. These mathematical attestations were used as a foundation for composition and grid systems constructions.

Applying this rationale, we have the first block in the grid with 10 pixels wide, the second block should also be 10 pixels wide, since the second number in the sequence is 1. The third block should then be 20 pixels wide (10 pixels from the first block + 10

Figure 55.

Base 32 pixel grid & Fib variation guide models



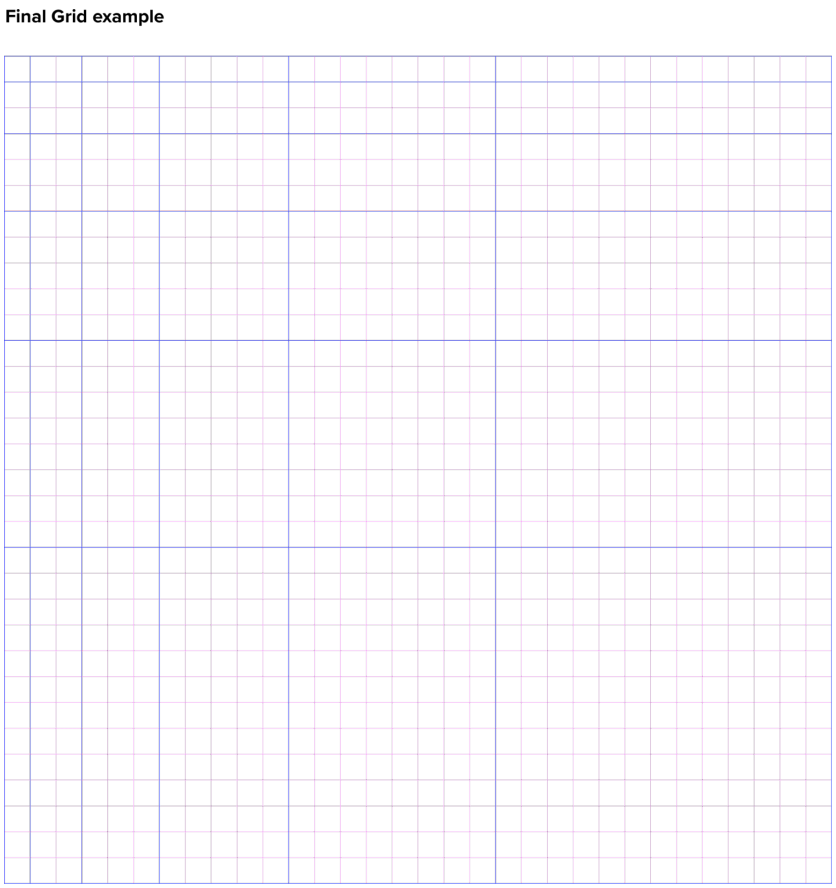


Figure 56.

Final grid example

The arrangement of elements on a page creates a framework for communication. By implementing an appropriate grid, users are directed through the content in a manner that is both effective and visually appealing.

While this is an introduction to the Spaceship Grid System, it offers a preview for what is a comprehensive guidance documentation to assist any designer or anyone who wants to learn to create organized and consistent layouts while also comprehending each phase of the process.

8.3.14. VISUAL IMPACT SCALE FRAMEWORK

In Spaceship, the use of semiotics for the creation and application of signs and symbols and how they are used to communicate meaning uses an underlying rationale of functional

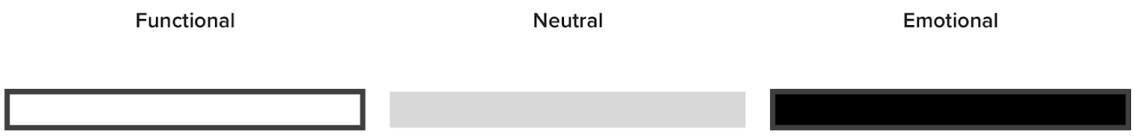


Figure 57.

Visual impact scale framework for visual language

and emotional levers on which the creative agent should understand the context for which the artifact is meant to convey meaning. By applying this *visual impact scale framework* (VISF), and adding the briefing and visual principles, the creative can start conceptualizing work in an optimized and directive way.

This VISF is a tool used to evaluate the effectiveness of visual language in conveying a message or eliciting a particular response in different scales of this visual language. Ranging from iconography, pictography, illustration, photography and motion to global content areas of web pages or printed mediums.

8.3.14.1. FUNCTIONAL

Functional, as an attribute, is straightforward and utilitarian in nature, with a primary focus on conveying information quickly and efficiently. It's a direct call to action. This type of application is often used in technical or detailed information contexts, where accuracy and clarity are essential. Present complex information in a clear and concise manner.

Bring clarity, to be direct and technical in representation of information, conveys objectivity, confidence, trust in the journey to accomplish a goal.

8.3.14.2. NEUTRAL

Neutral applications of meaning and form generation are objective and impartial, with a focus on presenting information in an unbiased and balanced way. This type of application of the visual language is often used in contexts where objectivity is valued to render e.g. empty system states in user interface for feedback. Other examples of neutral visual language applications include photography and illustrations that

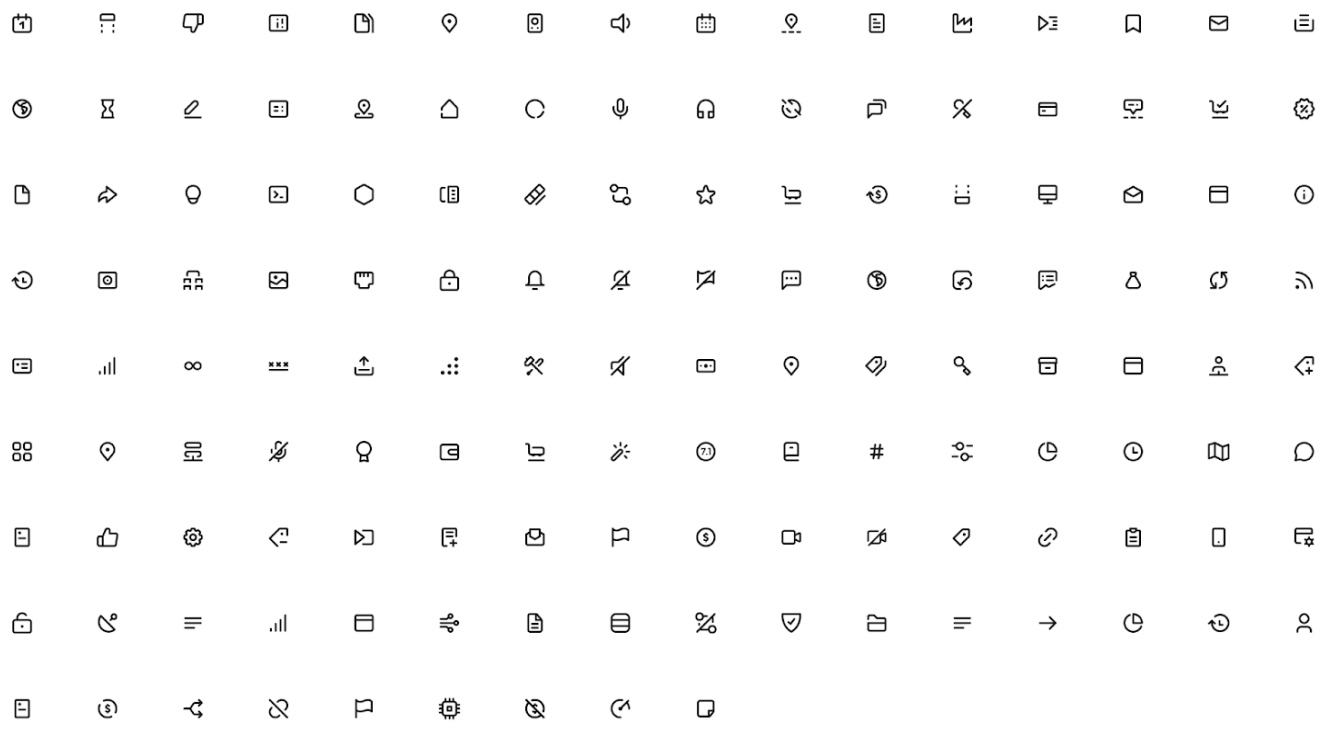


Figure 58.

General icons spaceship

aim to represent reality accurately and without bias.

8.3.14.3. EMOTIONAL

The emotional end of this scale is designed to build exploration areas that evoke a particular subliminal response from the viewer, such as happiness, curiosity, wonder, or any abstraction that acts as a positive stimulus for engagement. The goal is to create a connection between the viewer and a particular product or brand. Color scales, composition, and other visual elements are combined in thoughtful and specific ways to create a specific mood or feeling.

8.3.15. ICONOGRAPHY

Icons are visual elements that represent concepts, actions, or objects and communicate complex ideas quickly and efficiently. As such, they are a fundamental part of a design language vocabulary, helping to create a shared visual language that facilitates communication and enhances usability. By using a consistent set of icons, designers can create a sense of familiarity and trust among users, which can lead

Iconography distinguishes three layers of pictorial meaning: representational meaning, iconographical symbolism and iconological symbolism.[161]

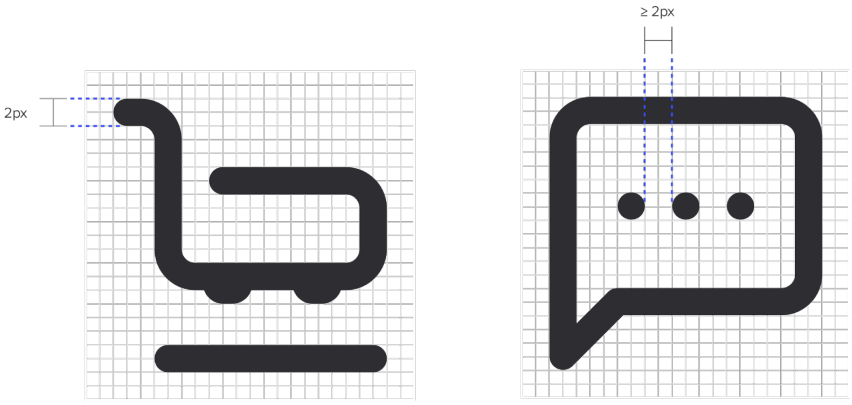


Figure 59.

Icon grid and spacing

to increased engagement and satisfaction.

Jenifer Tidwell, explains that "icons are the simplest and most universal way to convey concepts and commands visually."[160] Icons can be classified into several categories, including symbolic icons, which represent an abstract concept, and literal icons, which depict a physical object or action. By using a combination of these types of icons, designers can create or expand a current visual language that is both informative and engaging.

Icons in this visual language environment are used to convey functional information, building on top principles from the VISF. Such examples can be see in Figure 57.

The guidelines to build icons follow previous principles already discussed in previous sections, where grid, composition, color e.g. are used for optimal and consistent application. These rules are applied and documented for further development from new designers.

Icons are developed for filled and stroked versions. Filled icons have higher recognizability, they must be consistent to maintain aesthetic unity of an icon set. Making sure that the icons in the stroke version and in the filled version are all in the same style is key, for they're designed also in

160. Tidwell, Jenifer. 2005. Designing Interfaces: Patterns for Effective Interaction Design.

161. Jewitt, Carey. 2000. "The Handbook of Visual Analysis." The Handbook of Visual Analysis, 1–224. p.9

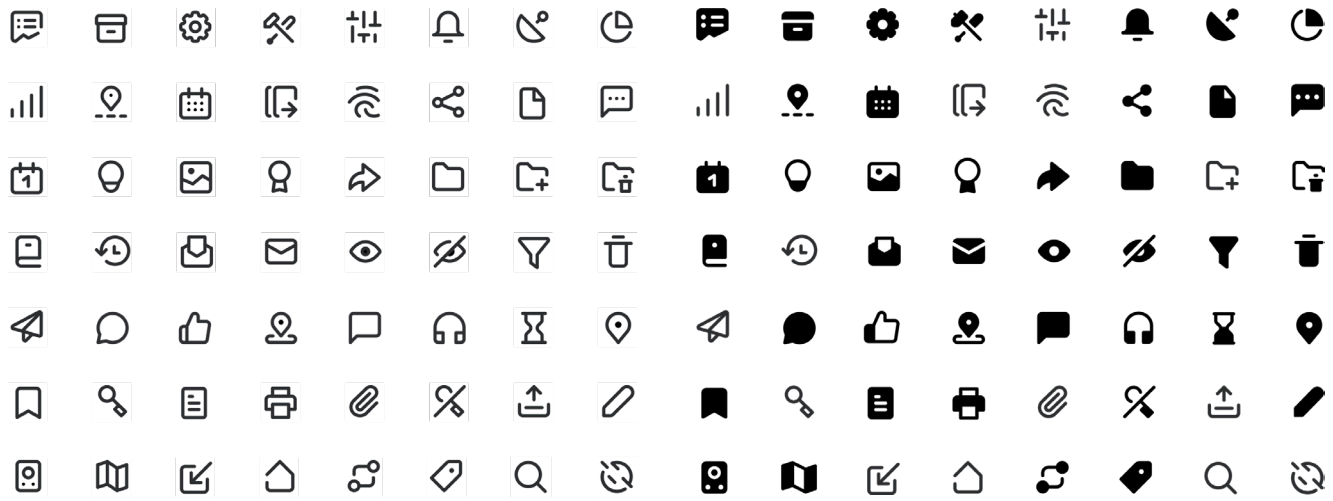


Figure 60.

Icons stroked version example

Figure 62.

Icons filled version example

scope of microinteractions based on transitions on user action, which can also trigger animation between a stroked to filled version and backward.

Figure 61.

Icons default sizing

Iconography is produced and distributed in standard sizes through the tooling ecosystem for internal consumers.

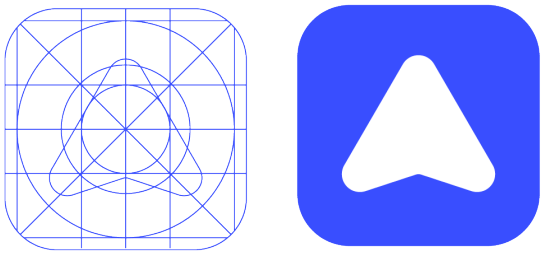


Figure 63.

iOS Spaceship icon example

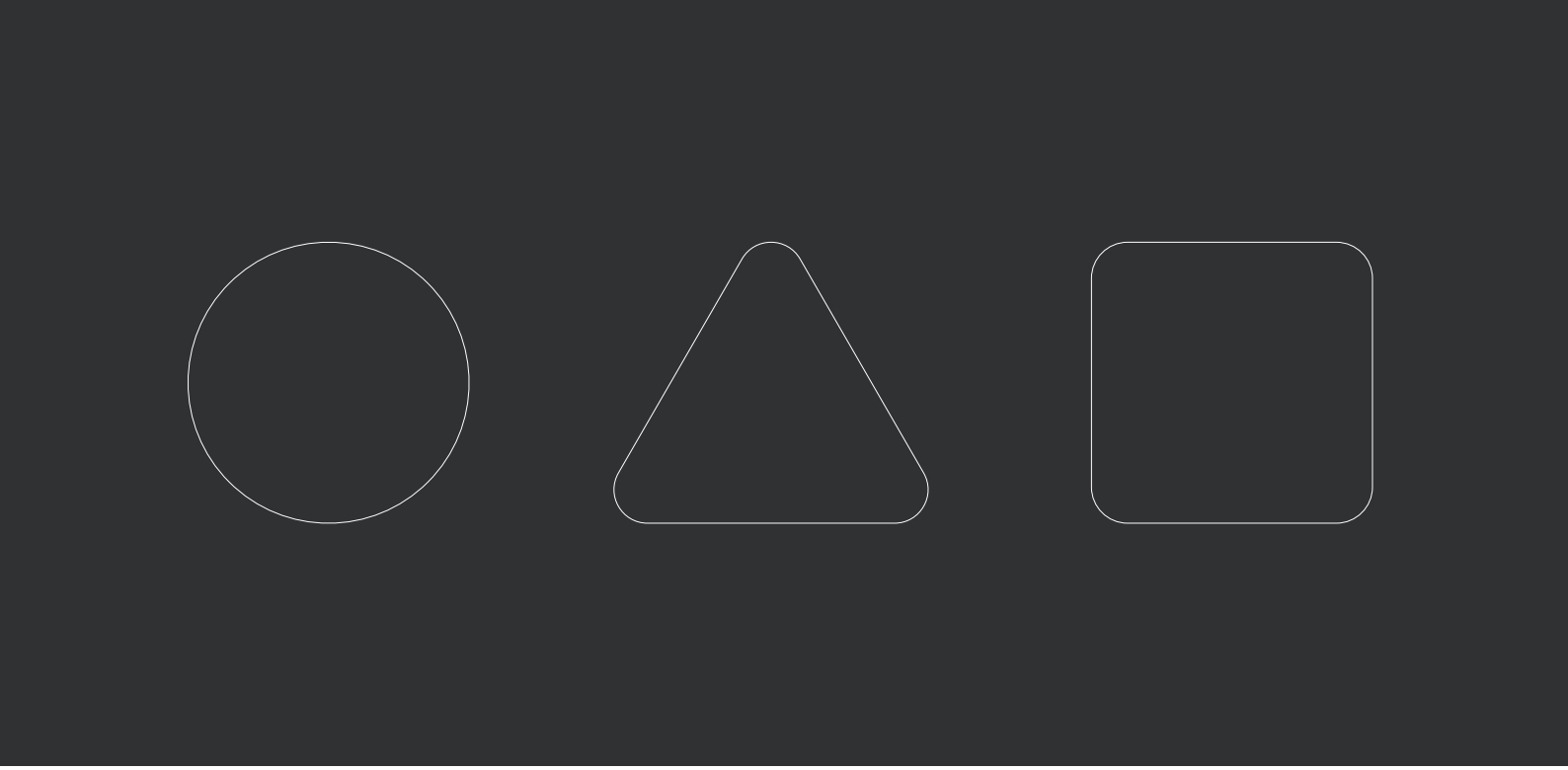


Figure 64.

Visual alphabet: core shapes

8.3.16. VISUAL LANGUAGE

8.3.16.1. ALPHABET

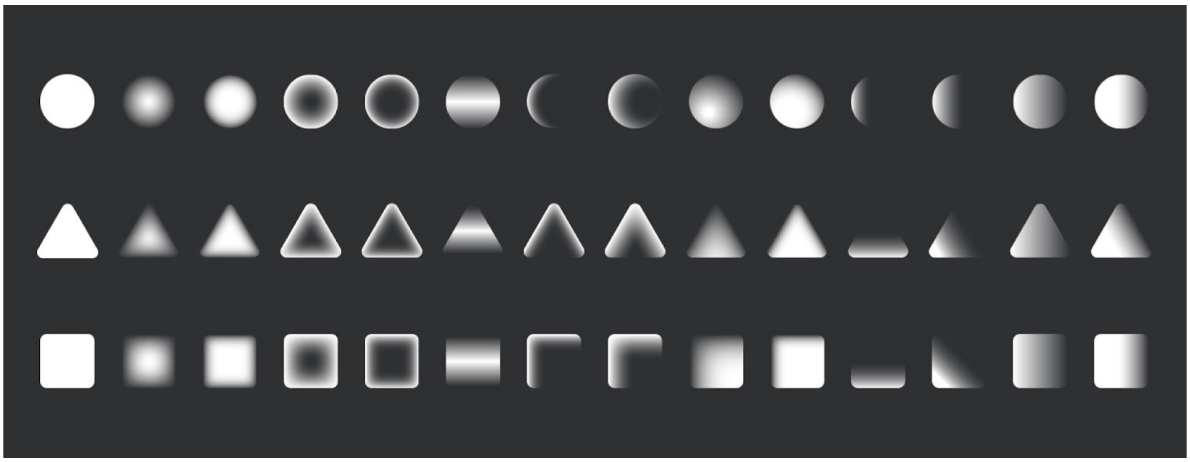
The visual alphabet is based on 3 core shapes: the circle, square and triangle. Simplicity and geometric essence form these basic shapes that translate that same baseline for building new imagery.

8.3.16.2. CHARACTERS

From the 3 core shapes the following alphabet is formed. These characters are the building blocks of the visual communication system. The possible combinations are endless,

Figure 65.

Visual Alphabet: Characters



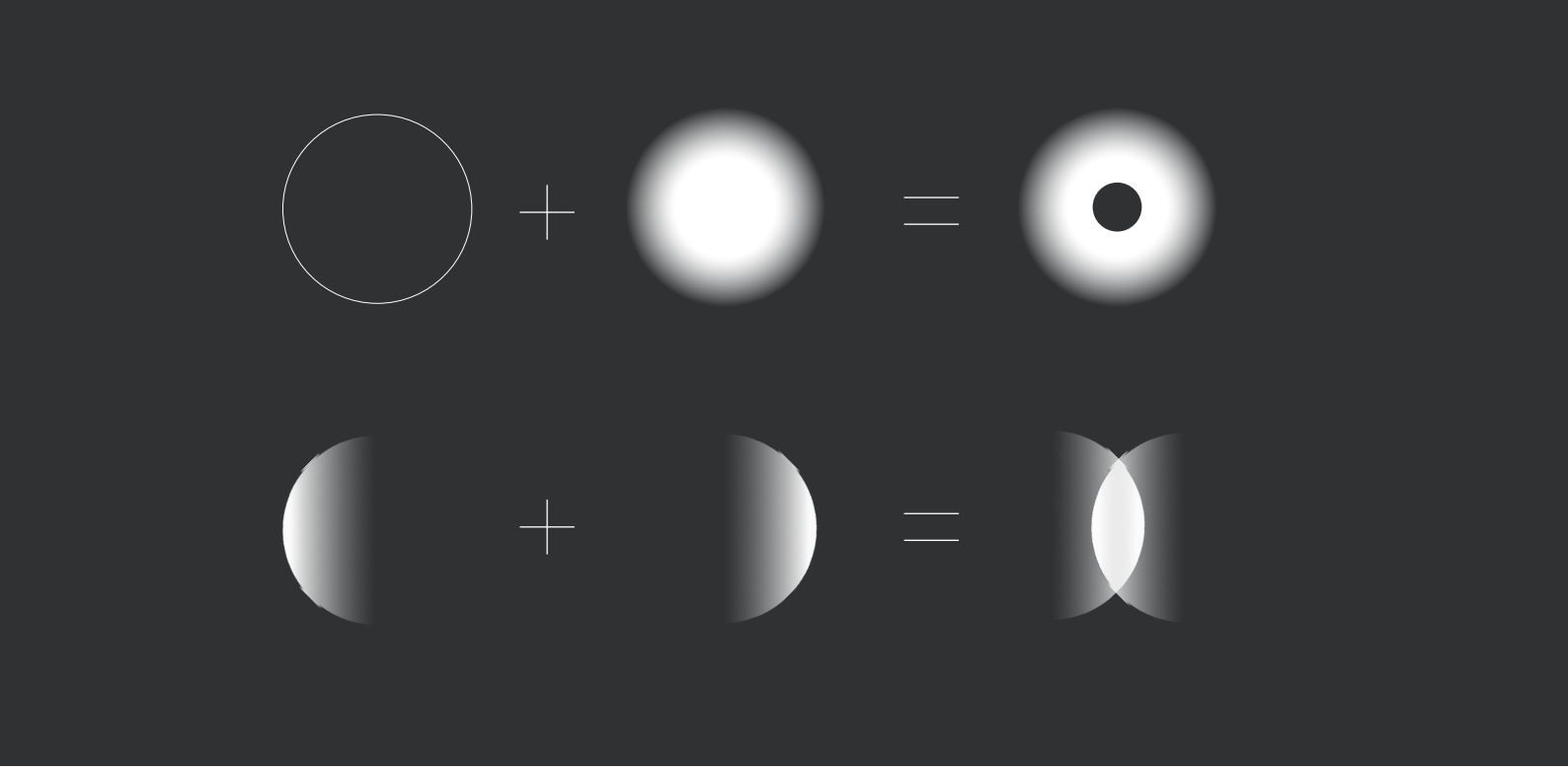


Figure 66.

Character combination examples

allowing to create any kind of visual output.

8.3.16.3. VOCABULARY

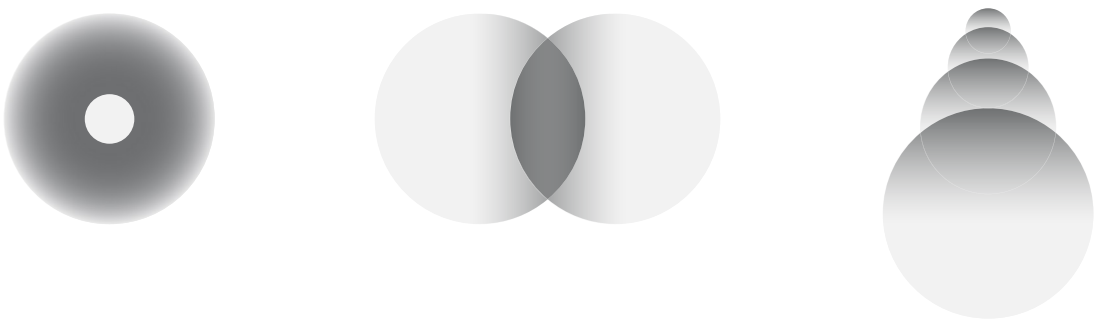
Spaceship visual vocabulary starts with simple ideograms. By combining two or more characters, a creative agent is able to create singular representations of ideas and concepts. This is the most primitive and universal way of human communication and its effectiveness is possible to be tracked through time.

The alphabet already provides a wide range of gradient variations, creating a complete set of building blocks for visual asset creation. The gradient properties of the characters can not be altered.

The construction guidelines of the current characters are

Figure 67.

Ideograms



Imagine Connect Launch

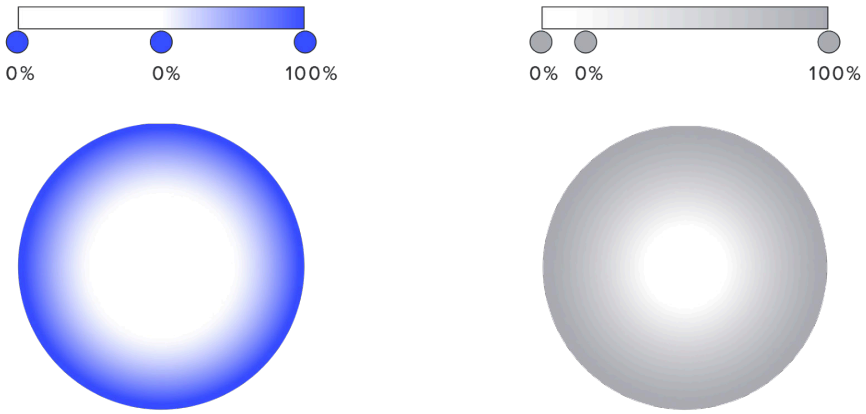


Figure 68.

Gradient Integrity Dos and Don'ts.

available to be consumed and inform the creation of additional ones. This is a regular pattern in any knowledge creation for any design initiative.

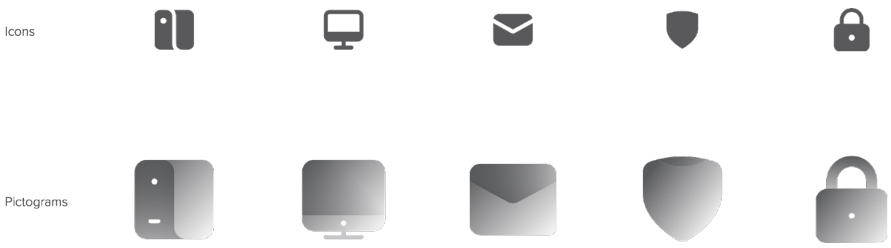
8.3.17. PICTOGRAPHY

These symbols or images can represent objects, concepts, or ideas. They are used to amplify the general usage of iconography in terms of complexity addressing and scale. These artifacts are used also to convey information quickly and effectively to a diverse audience.

In the present visual ecosystem, and when creating pictograms it is a good practice to check iconography solutions. If an appropriate solution exists it can serve as an inspiration for pictogram creation, because both types should be visually connected. A pictogram can add complexity of meaning to an existing icon and so extends the potential for flexibility and combination.

Figure 69.

Visual relation between iconography and pictographs in regular application



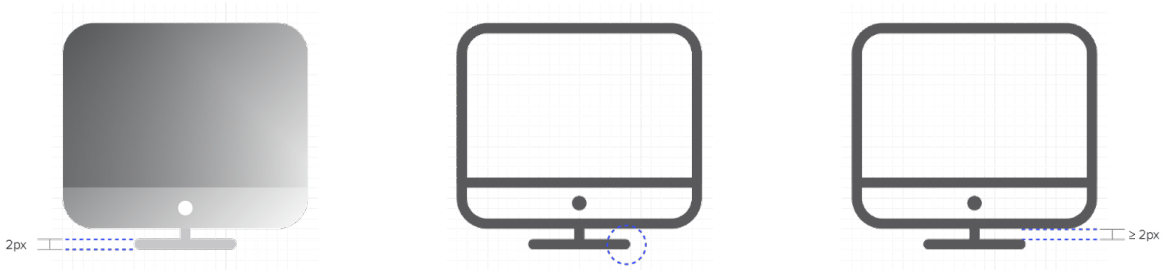


Figure 70.

Pictogram construction guidelines example

In this matter, a pictogram can be built by a combination of different, but complementary concepts, that combine to form a greater concept.

These visual artifacts follow the same methodology, as their parents elements, to be built. For the sake of simplicity, color usage is being omitted in the application of these references and guidelines.

8.3.18. MICRO ILLUSTRATIONS

Composition of micro-illustrations consists of functional and emotional elements that create a balance to ensure that the message is clear enough while also creating an emotional connection with the brand.

Literal elements are used to communicate objects, products, services and other more obvious things in a message.

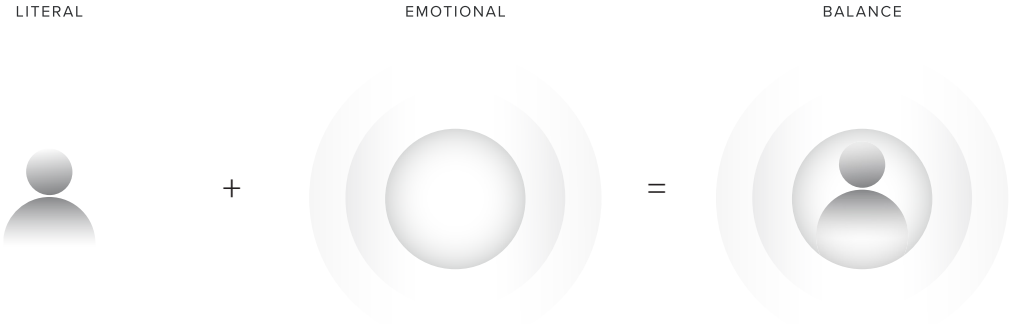
Micro-illustrations can be used in multiple contexts. System notifications are functional blocks of information, so only notification colors and SPS Grey colors

Figure 71.

Pictogram: regular and composite

Figure 72.

Functional and emotional balance



BE CLEAR

USE GEOMETRY

BE SIMPLE

Figure 73.

Functional application

should be used for these micro-illustrations.

Both micro illustrations and composite pictograms are important visual elements that can be used to enhance communication in design. However, they differ in their level of complexity and their intended purpose.

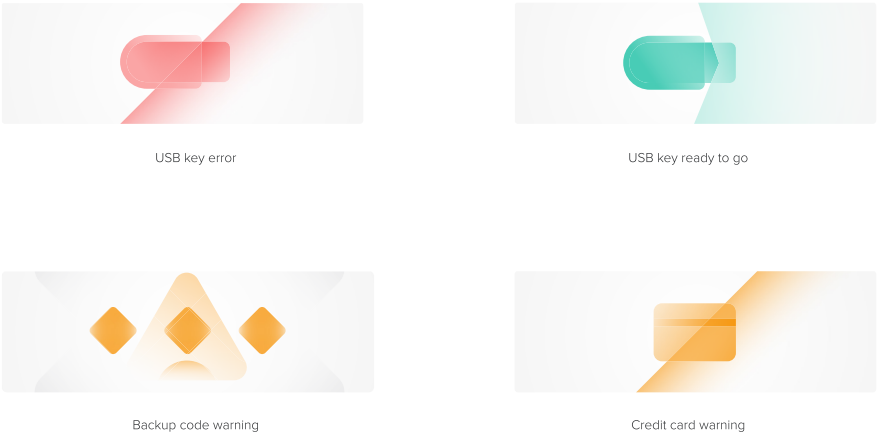
Micro illustrations are small representations that are used to convey specific information or ideas. They should help guide users through a process or highlight specific information, and prime meaning to available written information.

On the other hand, composite pictograms are a more abstract form of visual communication that uses simple geometric shapes to represent concepts or ideas. They are composed of multiple individual shapes or symbols, which are combined to create a more complex image. Composite pictograms are often used in signage for wayfinding systems, where they need to be easily recognizable from a distance and quickly convey information. This rationale is applicable to digital platforms UIs.

While both micro illustrations and composite pictograms can be effective visual elements in design, they are used in different contexts and serve different purposes. Micro illustrations are used to add detail and visual interest to a design, while composite pictograms are used to quickly and easily communicate complex ideas or concepts.

Figure 74.

Micro-illustration for notifications



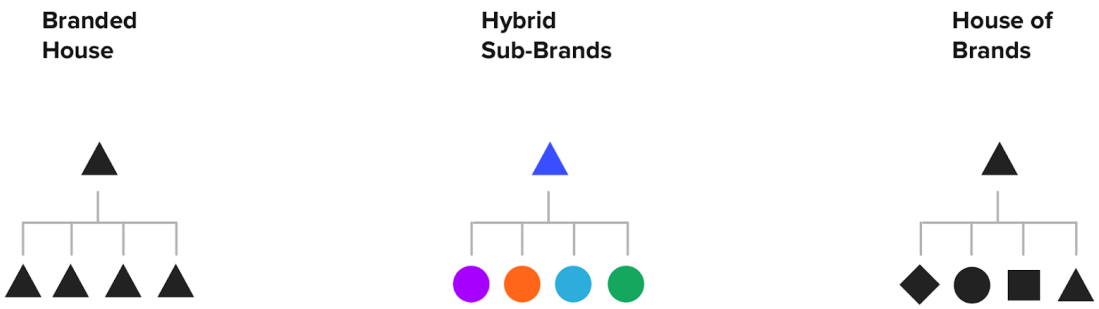


Figure 75.

Spaceship Brand Architecture

8.4. BRAND ARCHITECTURE

The conditions and requirements of this brand serve as the foundation for developing a framework for creating other brands or products. This framework includes processes and guidelines aimed at improving the creative process and accelerating *time-to-market.*[162]

A strategic decision is required from the executive team to validate the designers research, assumption(s) and suggestion(s).

An hybrid or endorsing brand:

- A master brand
  - Sub-brands
  - Third-Party(ies)

A flexible approach to branding involves packaging brands under a master brand, while providing separate identities to brand extensions that may or may not be associated with the master brand, depending on the strategy and context. This approach allows for independent strategies for brand extensions, while also leveraging the equity of the master brand when necessary.

By understanding the requirements for every component of a product range, we can establish the necessary assets for a toolkit for each brand or product. These will serve as the fundamental assets and the starting point for product communication, developed in accordance with master brand guidelines.

8.4.1. CREATIVE PROCESS

The creation of sub product identities is therefore a challenge related to such strategic direction.

162. Vesey, Joseph T. 1992. "Time-to-Market: Put Speed in Product Development." Industrial Marketing Management 21 (2): 151–58.

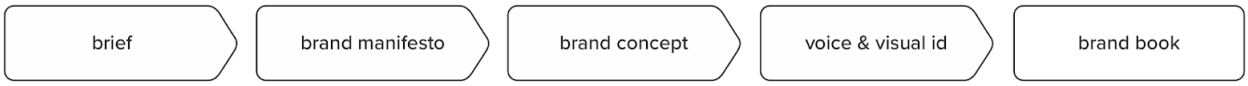


Figure 76.

Creative process key steps

A creation team is built dynamically, from a group of core professionals and other groups of expertises that are located inside other business units. Consists of a group of experts who work closely together to develop the identity for a specific product or service, while ensuring complete alignment with the product briefing, design language, creative vision and guidelines.

When such working group is defined, the following sequence of events unfolds as represented in Figure 75.

As a result, each sub brand is an independent visual identity, which is built from a set of principles that are distilled from the brand manifesto. The fundamental design tokens are shared, like typography, space, composition.

Color is explored by harmonic proximity in the spectrum horizon lines, and the toolkits created in the form of brand books serve as guidance and reference for further teams to build on top of and to use in a consistent manner but yet ensuring a diverse application potential.

To comply with the Spaceship Design System color requirements, each product is assigned a unique color that ensures all visual needs are met, following patterns defined in the Color section, depicted e.g. in Figure 40.

The focus of a system color is on the readability and accessibility, so if none of the main color range has a 3.0:1 minimum contrast ratio, a new color must be chosen — keeping the general visual characteristics.

All the colors, tints and shades are created in a Spaceship internal algorithmic generator. This assures the best customization and consistency through all platforms. Regular tests are performed to

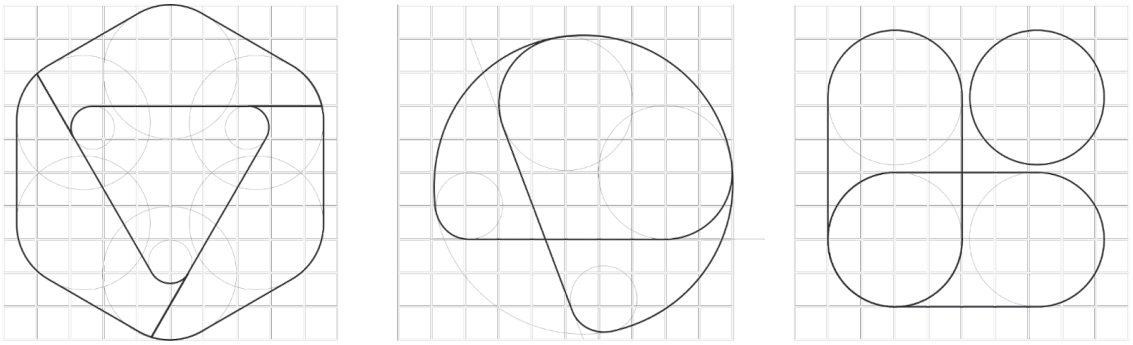


Figure 77.

Sub Identities 10x10 construction grid

check all the visual parameters and required contrast ratios for web content accessibility guidelines.[163]

8.4.2. SUB IDENTITIES

8.4.2.1. OVERVIEW

In this chapter we'll briefly address the application of Spaceship design principles for the creation and standardization of guidelines for sub identities creation. This approach is under the guidance of the strategic decision of a hybrid brand architecture.

8.4.2.2. SYMBOL

The Spaceship sub-brand symbols are designed to respect a 10 x 10 grid. They have a geometrical basis with simple shapes and rounded edges. An extra effort should be made to ensure a premium form construction and fit to the grid.

8.4.2.3. WORDMARK

The use of Gotham Rounded was based on its connection to the master brand and therefore reinforced legibility and lightness. The rounded edges of the font complement the logo symbol, creating a cohesive appearance.

For the product wordmarks, a combination of light and medium weights are used, with no spacing between the words to maintain visual impact. To ensure consistency, the text should be in SPS Dark Gray or white for the colored background version, and

Figure 78.

Sub identity wordmark guidelines

163. "Web Accessibility Color Contrast Checker - Meet WCAG Conformance." n.d. Accessible Web (blog).

Figure 79.

Sub identity horizontal lockup guideline

black or white for the high contrast version.

8.4.2.4. HORIZONTAL LOCKUP

The logo lockups have been designed to achieve the perfect balance between the wordmark and symbol. The lowercase x-height of the wordmark serves as a standard for determining sizes, margins, and spacing between elements. To maintain a consistent brand identity, all new logos must adhere to the established design principles and not disrupt the existing ecosystem.

A vertical lockup is also documented, that will not be displayed in this chapter.

8.4.2.5. COLOR

The main colors are chosen mainly depending on the product concept, specific communication, and systematic needs. Having in mind the sub-brands portfolio, there are no color restrictions, so each sub-brand has its distinctive color palette to effectively define its identity.

The product brand features a unique selection of secondary colors that are utilized to enhance visual communication materials, including graphic elements and illustrations. SPS Dark Gray serves as a color reference in each brand's secondary color palette, while additional colors can be added to ensure optimal brand communication. These colors are carefully chosen with the brand's best interest in mind.

To establish a distinct digital presence, each product has been assigned a system color, to be propagated by Spaceship Design System. The primary focus is on readability, and if none of the main colors meet the minimum 3:1 contrast ratio, a new color must be selected. However, the new color must retain the overall visual characteristics of the product.

To expand the range of visual possibilities and applications, a set of tints and shades are created based on the previously selected colors.

9. EXPERIENCE

9.1. OVERVIEW

An integral part of the Interactive branch of the Global Design System is proposed in the next section. To this end we'll address the HCIS, a set of guidelines to create and manage user experience (UX) design at scale, by optimizing the effort on a large scale by reducing duplication and establishing a shared vocabulary and visual consistency across various mediums, pages, and channels.

9.2. FOUNDATION

Spaceship Human Computer Interaction System (HCIS) is the materialization of the Spaceship brand into digital Design Principles, encompassing interface assets documentation and code packages. It serves as the single source of truth for UX conceptualization and interface creation, providing guidelines, rules, and constraints for designing the best user experience. HCIS is designed to facilitate the coherence and efficiency of new digital environments creation, while also serving as a catalyst for innovation and iteration.

The HCIS has a dedicated and centralized team, in charge of delivering the most beautiful and seamless experience, while sharing the best design principles across the company and associated products. Given the inherent complexity of technological products, the HCIS aims to humanize the interface and provide usability through aesthetic simplicity. The goal is to identify and implement patterns that solve systematic problems in a network of complex and highly

technological solutions. These patterns enable contributors and users of this service/product to work faster, more efficiently, and with focus on the right problems to be solved, while ensuring the end-users and customers have a cohesive and enjoyable experience.

9.2.1. PRINCIPLES

The principles of the HCIS serve as guiding tenets for the company, UX/UI designers, and general consumers in generating new visual elements and human-computer interfaces that offer a warm welcome into detailed and complex information, while also providing a relaxed journey within product flows.

Simplicity: Beauty arises from accomplished objectives. This system strives to provide a straightforward and intuitive path for end-users to achieve their intended goals. Avoiding complexity and unnecessary detours is crucial to prevent frustration and ensure a smooth user experience. The system emphasizes clear, understandable, and modular design patterns that are easily learned and applied by the company and consumers.

Consistency: A fundamental pillar of a well-designed interface. Consistency in communication and visual coherence creates a cohesive and harmonious experience for users. A cluttered interface with multiple voices creates noise and distractions, hindering a user's journey and raising doubts about one's ability to achieve objectives. HCIS emphasizes consistent communication and visual

coherence to ensure a seamless and delightful user experience.

Scalability and mutability: HCIS is designed to allow for new appropriations and addressing unknown challenges. It follows scalability principles and provides intertemporal design guidelines to ensure readiness for future problems. The system is open ended, work in progress, requiring flexible and accurate maintenance to stay up-to-date and relevant by constantly injecting state of the art industry contemporary and future patterns.

Collaboration: User interface and code architecture are developed collaboratively, fostering a transparent and collaborative approach. Design and development work hand-in-hand, with code validation as an integral part of the process. HCIS thrives on and encourages a cross-functional and collaborative approach to design challenges, leveraging multiple perspectives to push boundaries and achieve the best solution.

9.3. GOVERNANCE MODEL(S)

Governance models for HCISs refer to the frameworks and strategies used to manage and maintain the development, implementation, and evolution of HCIS within an organization. These governance models ensure that the HCIS remains consistent, efficient, and effective in delivering the desired user experience across different products and platforms.

One commonly used governance model for a HCIS is the centralized model, which is the case for this particular system, where a dedicated team

Centralized governance models have been used effectively by organizations to ensure consistency in design principles, documentation, and code implementation across different products and platforms[164]

"Federated governance models can enable teams to tailor the HCIS to their specific requirements while still adhering to the overall design principles and guidelines"[165]

or department is responsible for overseeing all aspects of the HCIS, including design principles, guidelines, documentation, and code packages. This team acts as a central authority and enforces strict standards and processes to ensure consistency and coherence in the HCIS.

Another governance model for HCISs is the federated model, where multiple teams or departments within an organization contribute to the development and maintenance of the HCIS. Each team or department is responsible for a specific area of the HCIS, such as design patterns, documentation, or code packages, and works autonomously within the overall framework of the HCIS governance. This model allows for more flexibility and agility in adapting to the unique needs of different products or platforms.

While HCIS is based on the centralized model, at this moment in a specific contextual timeline of business developments, a progressive transition or evolution, related to complexity and other factors, is surfacing the application of federated governance principles to this system, denoting an organic evolution of primarily centralized design approach towards a decentralized, more mature one.

In addition to centralized and federated models, there are also hybrid governance models that combine elements of both approaches. For example, a "hub-and-spoke"[166] model may have a central team overseeing the overall strategy and standards of the HCIS, while also empowering decentralized teams to contribute to the HCIS based on their specific expertise and context. This model allows for a balance between

164. Grinter, R. E, and J. Brown. n.d. "A Design Space for Governance in Design Systems." In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (pp. 1-13).

165. Mueller, F., S. Ismar, and P.M. Langdon. 2016. "Design Systems for Human-Computer Interaction." In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (pp. 109-120).

166. Liu, Shaofeng, Dulekha Kasturiratne, and Jonathan Moizer. 2012. "A Hub-and-Spoke Model for Multi-Dimensional Integration of Green Marketing and Sustainable Supply Chain Management." Industrial Marketing Management, Green marketing and its impact on supply chain, 41 (4): 581–88.

consistency and flexibility in HCIS development and maintenance.

This is the best expression of the above-mentioned evolution of HCIS.

Effective governance of HCIS requires clear roles, responsibilities, and communication channels, as well as mechanisms for feedback, review, and iteration. It also involves regular updates and improvements to keep the HCIS relevant and aligned with evolving user needs and technological advancements.

9.4. GUIDANCE

The foundations of components in a Human-Computer Interaction System are based on several key principles and concepts that are essential for designing and implementing effective user interfaces. These foundations provide the basis for creating reusable, modular, and scalable components that facilitate the interaction between users and computer systems. In this section, we will delve into the technical details of these foundations.

9.4.1. USABILITY PRINCIPLES

Usability is a critical aspect of HCIS components, as they need to be designed in a way that is easy to use and understand by users. Usability principles such as learnability, efficiency, memorability, error prevention and recovery, and satisfaction, as defined by Nielsen's usability heuristics[167] are key considerations in the design of HCIS components. These principles ensure that components are intuitive, efficient, and error-free in their operation,

167. Nielsen, Jakob. 1994. "Enhancing the Explanatory Power of Usability Heuristics." In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Celebrating Interdependence - CHI '94, 152–58.

and provide a positive user experience.

9.4.2. USER-CENTERED DESIGN (UCD)

UCD is a fundamental concept in HCIS design that emphasizes understanding and incorporating the needs, goals, and preferences of users throughout the design process. This involves conducting user research, usability testing, and user feedback analysis to inform the design of components that align with the users' mental models, cognitive abilities, and interaction preferences.[168] UCD ensures that HCIS components are designed with a user-centric approach, resulting in interfaces that are usable, effective, and enjoyable for the end-users.

9.4.3. DESIGN PATTERNS

Design patterns are reusable solutions to common design problems that have been proven effective in various contexts.[169] In the context of HCIS components, design patterns are guidelines and best practices that define how user interface elements should be organized, presented, and interacted with to achieve specific user goals. Design patterns help in creating consistent and familiar interfaces, reducing cognitive load, and enhancing learnability and efficiency. Examples of design patterns for HCIS components include form validation, notification systems, navigation menus, and error handling.

9.4.4. INTERACTION PARADIGMS

Interaction paradigms refer to the underlying models or

168. Anderson, Nancy S. 1988. Review of Review of User Centered System Design: New Perspectives on Human-Computer Interaction, by Donald A. Norman and Stephen W. Draper. The American Journal of Psychology 101 (1): 148–51.

169. Gamma, Erich, Richard Helm, Ralph Johnson, and John Vlissides. 'Design Patterns: Abstraction and Reuse of Object-Oriented Design'. In ECOOP' 93 — Object-Oriented Programming, edited by Oscar M. Nierstrasz, 406–31.

metaphors that govern the way users interact with HCIS components. These paradigms define the fundamental principles and rules of interaction, such as direct manipulation, command-line, menu-based, or gesture-based interfaces. Interaction paradigms provide the foundation for how users perceive and interact with components, influencing their cognitive load, ease of use, and efficiency in performing tasks.[170] For example, the WIMP[171] (Windows, Icons, Menus, Pointing device) paradigm is commonly used in graphical user interfaces, while the conversational paradigm is prevalent in voice-based interfaces.

9.4.5. ACCESSIBILITY

Accessibility is a critical consideration in HCIS component design, ensuring that components are usable and accessible by a wide range of users, including those with disabilities. Accessibility guidelines, such as the Web Content Accessibility Guidelines[172] (WCAG) 2.0 or 2.1, provide technical and design recommendations for creating components that are perceivable, operable, understandable, and robust for all users, including those with visual, auditory, motor, or cognitive impairments. Accessibility features, such as keyboard navigation, alternative text for images, and captions for videos, are important considerations in the design of HCIS components.

170. Norman, Don. 1998. The Design of Everyday Things.
171. Feng, Jonathan L. 2022. "The WIMP Paradigm: Theme and Variations."
172. Initiative (WAI), W3C Web Accessibility. n.d. "WCAG 2 Overview." Web Accessibility Initiative (WAI). Accessed April 17, 2023.

9.4.6. TECHNICAL STANDARDS AND GUIDELINES

HCIS components need to adhere to technical standards and guidelines to ensure interoperability, consistency, and scalability. These standards and guidelines may include markup and formatting languages (e.g., HTML, CSS), programming frameworks (e.g., React, Angular), data interchange formats (e.g., JSON, XML), and other technical specifications that define how components are implemented, integrated, and deployed within a HCIS. Adhering to technical standards and guidelines define the best practices and conventions for implementing, integrating, and deploying components within a HCIS, ensuring that they work seamlessly together and meet the requirements of the system and ultimately the requirements of a superior user experience.

"Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - System and software quality models,"[173] compliance to technical standards and guidelines is crucial for achieving system and software quality in HCIS. Following these standards and guidelines promotes consistency, interoperability, and scalability, which are fundamental principles of building reliable and effective HCIS components.

9.5. FOUNDATIONS

Accessible through design tools such as Figma,[174] a Core Library — Foundations — distributes foundational design primitives such as typography, color,

173. "ISO/IEC 25010:2011(En), Systems and Software Engineering — Systems and Software Quality Requirements and Evaluation (SQuaRE) — System and Software Quality Models." n.d. Accessed April 17, 2023.

174. Figma: The Collaborative Interface Design Tool.

shadows and grids through the creative ecosystem. Other core satellite libraries that are fed from these Foundations and organized at the same root level, distribute components, iconography, graphics and more. This group of libraries represent the Core Library that is expressed and consumed by all teams.

9.5.1. TYPOGRAPHY

Typography serves as the foundation for creating effective hierarchies, organizing content in a meaningful way, and aligning elements purposefully to guide users through a product or experience. It is a crucial element in designing interfaces that are visually appealing and functional.

This system employs the Proxima Nova[175] typeface, designed by Mark Simonson. Proxima Nova is known for its geometric appearance and modern proportions, making it a versatile choice for a wide range

Figure 80.

Proxima Nova Typeface

175. Simonson, Mark. 2023. "Proxima Nova." Text/html. Mark Simonson.

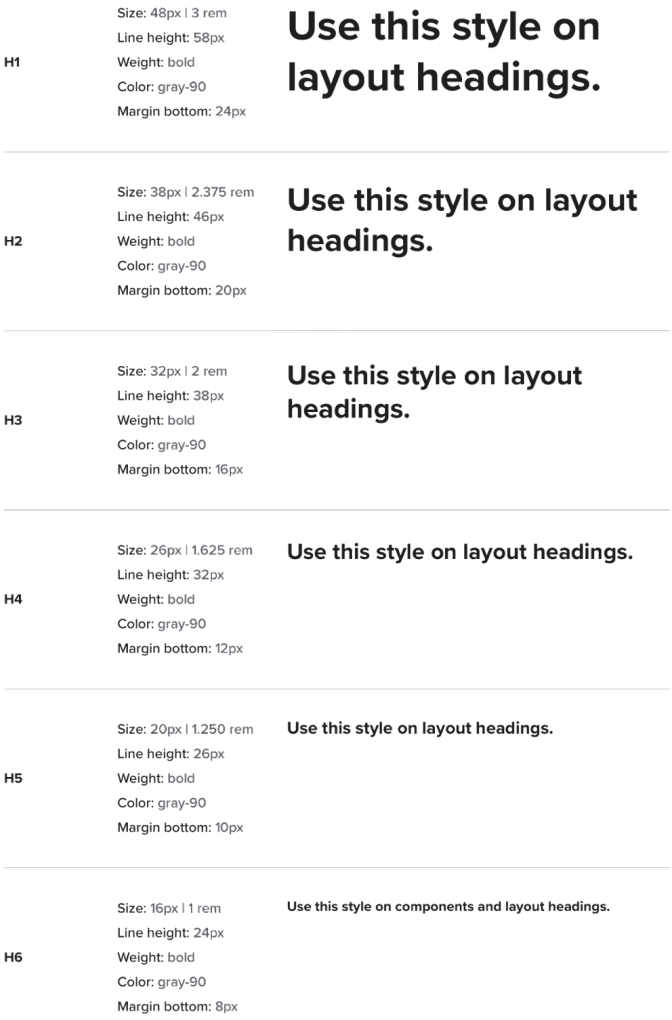


Figure 81.

Example of heading documentation.

of design applications. It offers up to eight different weights, three different widths, and extensive language support for Latin-based Western and Central European languages, Vietnamese, Greek, and Cyrillic scripts. Proxima Nova's versatility and extensive language support make it a suitable choice for creating visually appealing and readable typography within the Spaceship HCIS.

All styling specifications like weight, scale, margins, color are documented and distributed through design tools edition panels and available for consumption as documentation with usage examples, do's and don'ts.

It's important to highlight the relationship between the two main typefaces used in this project. Gotham Rounded is a variation of the original Gotham typeface, with rounded edges and a softer appearance. It has a more straightforward and geometric construction than Proxima Nova, which has a more humanist allure with its curved shapes and moderate angles.

While both typefaces share some formal affinities, such as clean lines, Gotham Rounded softer appearance gives it a more approachable and friendly rendering, while Proxima Nova's geometric appearance gives it a more reliable, functional formalization.

Gotham Rounded flexible geometric forms make it a great choice for designs that require

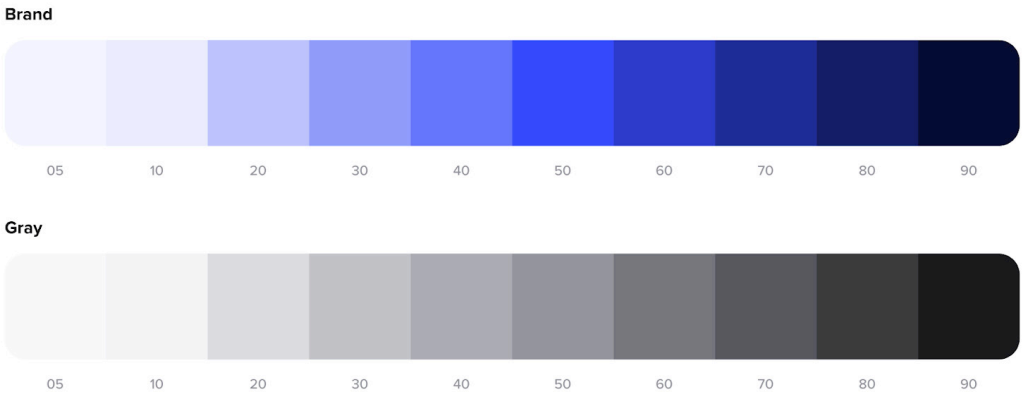
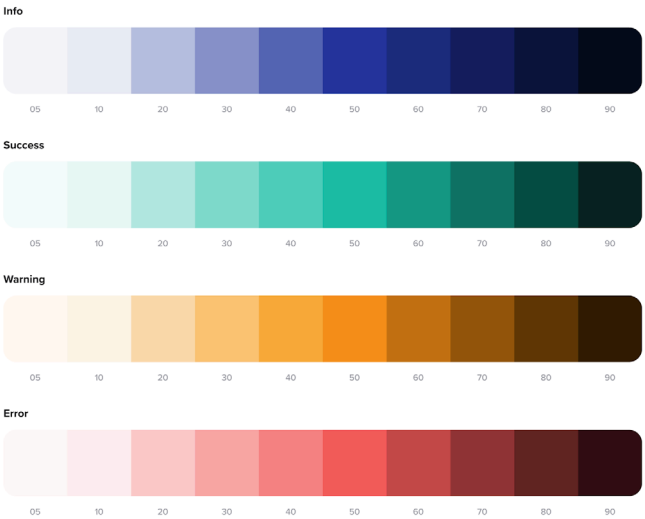


Figure 82.

Notification colors



a friendly and welcoming appearance, particularly when condensed forms are necessary for small spaces or materials that need to make a big impact.

Proxima Nova, on the other hand, is versatile and easy to read at a variety of sizes, which makes it popular for both body text and headlines.

However, one potential weakness of Gotham Rounded is that its rounded forms can make it difficult to read in long passages of text, particularly at smaller sizes. Its softer appearance may also not be suitable for all design contexts, particularly those that require a more serious or authoritative tone.

9.5.2. COLOR

Color choices within a design system are carefully curated and documented to ensure consistency and coherence across all components and interfaces.

Colors are typically defined using a color palette, which includes a set of predefined colors with specific names, values, and intended uses. These color palettes are often created based on established design principles, such as color theory, and may include primary, secondary, and accent colors. Primary colors are the foundational colors that form the base of a design system's visual identity, while secondary and accent colors are used for

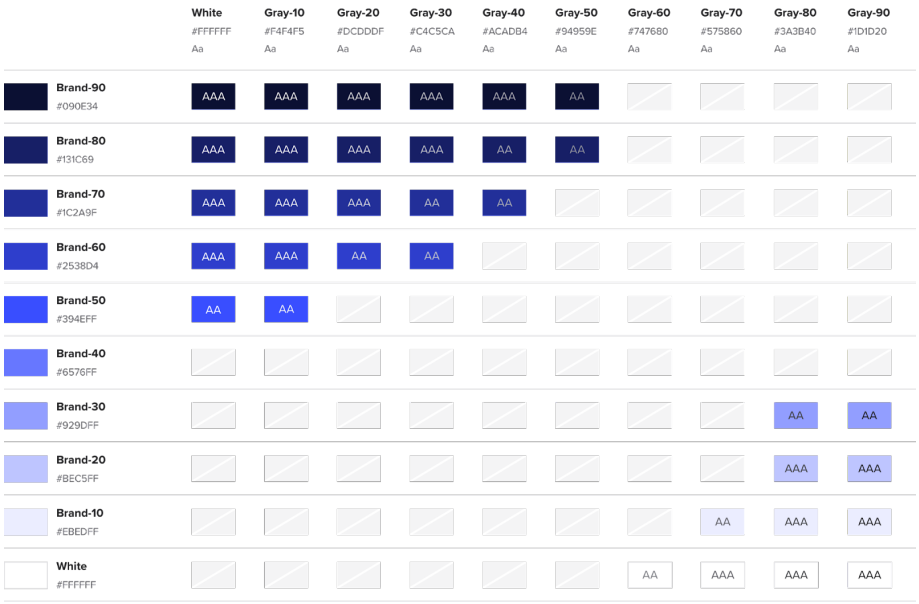


Figure 83.

Accessibility scale to spaceship blue

additional visual hierarchy and emphasis.

One popular approach to organizing colors in a design system is to use a modular and scalable system, such as the color tokens approach. Color tokens are typically defined as variables or constants in a design system's code or style guide, and they represent the different colors used throughout the system. These color tokens can be used consistently across all components, allowing for easy updates and maintenance of the color palette.

In addition to defining color values, guidance is provided on how to use colors effectively, such as color contrast ratios to ensure accessibility, color combinations to create visual harmony, and color usage guidelines for different contexts and devices.

Below we can see the primary and secondary colors, as to notifications semantic color usage.

9.5.2.1. ACCESSIBILITY SCALE — EXAMPLE

By applying an accessibility scale to colors, designers can ensure that their designs meet the minimum contrast requirements set by accessibility standards, such as the WCAG. These standards are designed to ensure that digital content is accessible to as many people as possible, including those with visual impairments, color blindness, or other visual disabilities. High contrast between text and background colors is crucial for readability, as it helps individuals with visual impairments to distinguish and understand the content more easily.

Figure 83 depicts an example of such an approach applied to a particular color, in the global color palette present in the system.

When applying accessibility standards, such as the Web Content Accessibility Guidelines (WCAG), to a color like #394eff in 10 different shades and tints with text on top ranging from #ffffff to #1d1d20 in 10 incremental steps, it is important to ensure that the color combinations meet the minimum contrast ratio requirements set by the WCAG.

The WCAG specifies three levels of conformance: A, AA and AAA.[176] In this project, the goal was to use AA and AAA targets. The AA level requires a minimum contrast ratio of 4.5:1 for normal text and 3:1 for large text. The AAA level requires a minimum contrast ratio of 7:1 for normal text and 4.5:1 for large text.[177]

To apply these standards, one can use a tool such as the WebAIM Contrast Checker[178] to determine the contrast ratio between the background color and the text color for each of the 10 shades and tints of #394eff. For each combination of background and text color, the contrast ratio is calculated and compared to the minimum requirements of the WCAG.

For example, let's consider the combination of #394eff with #ffffff for the lightest shade of #394eff. The contrast ratio between these two colors is 8.59:1, which exceeds both the AA and AAA requirements for normal text. Therefore, this combination passes both AA and AAA levels of conformance.

Now, let's consider the combination of #394eff with #1d1d20 for the darkest tint of #394eff. The contrast ratio

176. Initiative (WAI), W3C Web Accessibility. 'Web Content Accessibility Guidelines (WCAG) 2 Level AA Conformance'. Web Accessibility Initiative (WAI). Accessed 3 May 2023.

177. Initiative (WAI), W3C Web Accessibility. 'Text Has Minimum Contrast'. Web Accessibility Initiative (WAI). Accessed 3 May 2023.

178. 'WebAIM: Contrast Checker'. Accessed 3 May 2023.

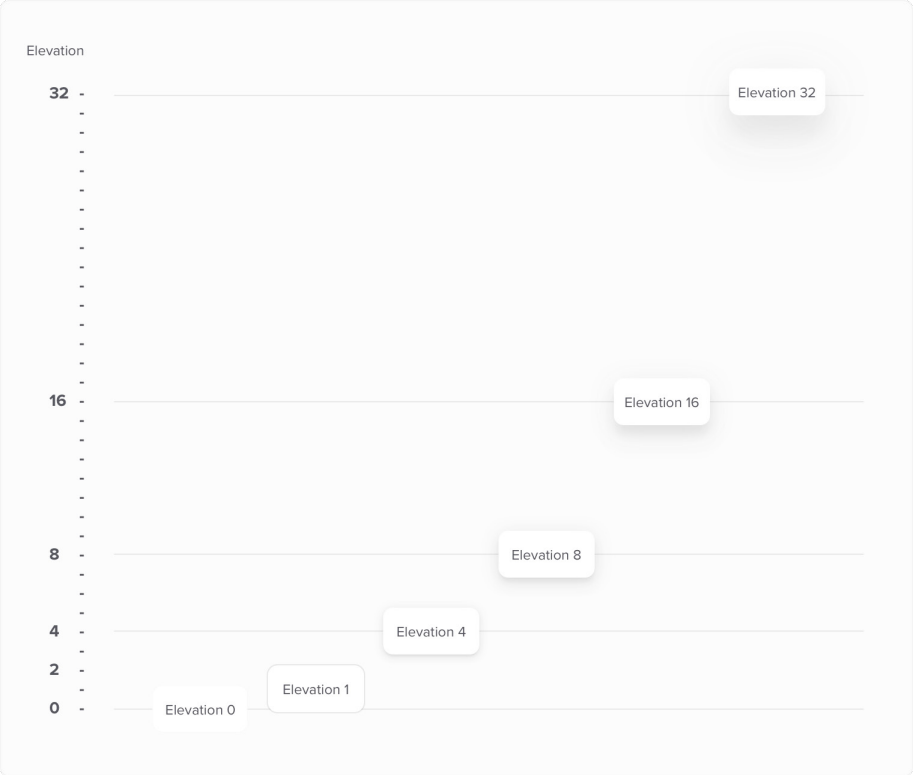


Figure 84.

Elevation scale

between these two colors is 2.11:1, which fails to meet the minimum requirements for both AA and AAA levels of conformance for normal text. Therefore, this combination fails both AA and AAA levels of conformance.

By applying the WCAG accessibility standards to each combination of background and text color for the 10 shades and tints of #394eff, we can identify which combinations pass or fail the minimum contrast ratio requirements. This allows designers and developers to make informed decisions about color choices that ensure the accessibility of their design for all users, including those with visual impairments.

9.5.3. ELEVATION

Different types of layers are positioned on different virtual planes, each with its own unique elevation possibility. Elevation refers to the perceived height above the base layer, creating a visual hierarchy and perceptual depth. The elevation of a layer is determined by the intensity and depth of the shadow it casts, which defines its visual effect.

Elevation	Elements
0	background
1	buttons, dropdowns, inputs
4	cards, cart widget, shopping cart
8	header, notifications
16	modals
32	promotional blocks

Figure 85.

Elevation scale applied to example components

Figure 86.

Shadow scale

9.5.3.1. SHADOWS

Shadows play a crucial role in conveying the hierarchy of elements in a user interface (UI), helping users distinguish between different objects and understand their relative positioning. As an object's elevation increases, the shadow associated with it grows softer and larger, while it becomes crisper and smaller as the elevation decreases. The value of the shadow corresponds to the elevation of the object it represents. For example, if an object has an elevation of 16, its associated shadow would also be referred to as *Shadow 16*.

9.6. PROCESS

In this section, we'll delve into more detail about the design process required to build the design infrastructure that will constitute the design libraries, which represents a collection of pre-designed and reusable user interface (UI) components, patterns, styles, and guidelines.

As tools and methodologies are constantly evolving, for the purpose of informing this work, we'll approach tree main design tools: Abstract,[179] Sketch[180] and Figma.[181]

The process of designing libraries of components typically involves the following steps:

Step 1: Design Component Creation - The design team creates individual components, such as buttons, forms, or icons, using design tools like Sketch or Figma. These components are designed to be reusable and follow established design principles, guidelines, and patterns.

179. "Version Control for Sketch | Abstract." n.d. Accessed April 17, 2023.
180. "Sketch." n.d. Sketch. Accessed April 17, 2023.
181. "Figma: The Collaborative Interface Design Tool." n.d. Figma. Accessed April 17, 2023.

Step 2: Component Library Creation - Once the design components are created, they are organized into a component library using e.g. the Abstract app. The component library serves as a central repository for storing and managing design components, ensuring version control and collaboration among team members and is accessed by Sketch app to be edited by the design team. This flow happens in the app, when performed in Figma.

Step 3: Library Organization, Documentation and Naming Conventions - Designers organize the components within the Figma library using naming conventions and structure that align with the design system and project requirements. This ensures consistency and ease of use when accessing components from the library.

Step 4: Versioning - With the Abstract app, the design team can create different versions of the component library. Each version represents a snapshot of the library at a particular point in time, allowing for easy management of changes and updates to components over time. Versioning helps in tracking changes, managing updates, and ensuring consistency across the system. Same rationale is applied to Figma.

Step 5: Collaboration and Review - Designers can collaborate and review changes in the component library using the Abstract app, and the same using Figma that promotes in document audio conversations, cursor chat and multiple editor real time

editing. They can make edits, provide feedback, and discuss changes within the app, ensuring that the components meet the desired design standards and guidelines.

Step 6: Integration with Workflow - Once the component library is finalized and approved, the design components can be integrated into the development workflow. Developers can access the component library, use the components in their code, and ensure consistency and adherence to the HCIS across environments and applications.

It's worth noting that the process of designing libraries of components may vary depending on the specific design tools, version control systems, and collaboration methods used by the design team. It's important to establish clear communication, documentation, and guidelines to ensure a smooth and efficient process for designing libraries of components within a human computer interaction system.

9.7. DESIGN OF DESIGN LIBRARIES

Let's approach this challenge, first by conceptual interdependency layers, on which a library is built. The interdependency between these layers is hierarchical, with each layer building upon the previous one.

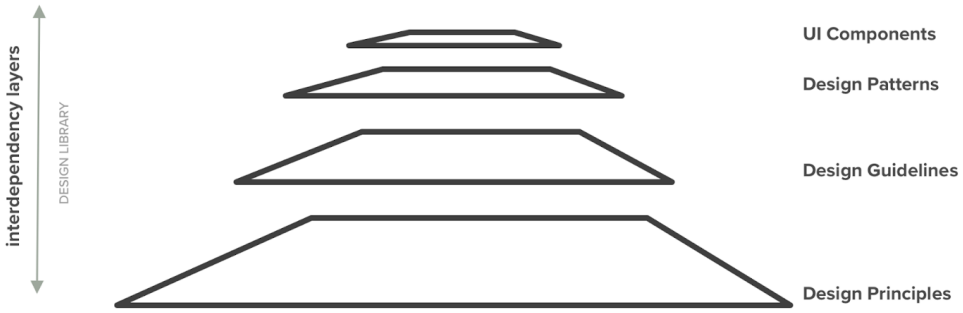


Figure 87 .

Four-layer interdependency for design libraries

9.7.1. LIBRARY INTERDEPENDENCY LAYERS

Design Principles: This layer represents the foundational design principles that guide the overall design approach and philosophy of the HCIS. These principles provide high-level guidance for the design process and serve as the basis for all design decisions.

Design Guidelines: This layer includes the specific guidelines and standards that are derived from the design principles. These guidelines provide more detailed instructions on how to implement the design principles in practice, including typography, color usage, spacing, and other visual and interaction design guidelines.

Design Patterns: This layer consists of reusable design patterns or templates that are based on the design guidelines. These patterns provide pre-designed solutions for common design problems or interaction patterns within the HCIS, such as form layouts, navigation patterns, and content display patterns.

UI Components: This layer includes the actual UI components that are built based on the design patterns and guidelines. These components are the building blocks of the user interfaces within the HCIS, such as buttons, forms, icons, and other UI elements that are designed and implemented based on the design principles, guidelines, and patterns.

The design principles provide the foundation for the design guidelines, which in turn inform the design patterns, and ultimately guide the development of the UI components. This interdependency ensures that

the design library is cohesive, consistent, and aligned with the overall design approach of the HCIS.

Applying the principles of Atomic Design to the first layer of the chart, which defines the 4-layer interdependency for design libraries, starts a new structure and involves breaking down the layer into smaller, more basic UI elements or components, referred to as atoms in Atomic Design. These atoms serve as the foundational building blocks for creating more complex components in the design library. This first layer in the chart may include individual UI elements, such as buttons, icons, input fields, and other visual elements that are used in the design library. These individual elements can be considered as atoms because they are the smallest and most basic components that can be reused and combined to create more complex components and can be further organized and categorized based on their characteristics, functionality, or visual appearance. For instance, buttons of different styles, sizes, or states (e.g., normal, hover, active) can be categorized as different atoms within the first layer.

9.7.2. LIBRARIES ARCHITECTURE

Figure 86, depicts the interdependency for a Core Library, Shared Library, and Local Library based on their relationships in a hierarchical structure. The Core Library serves as the foundation and includes the basic building blocks of the design

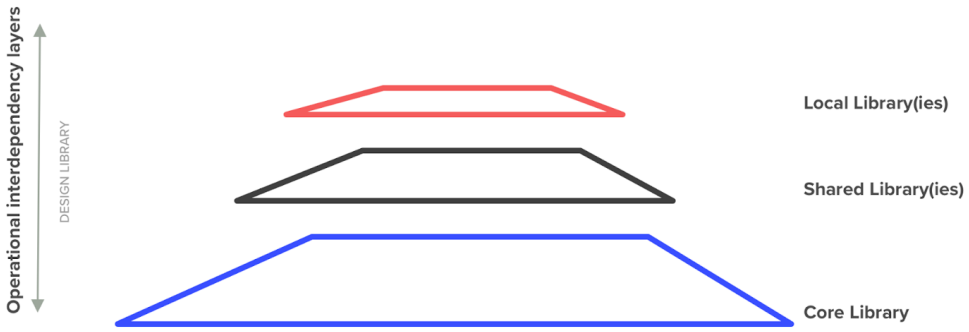


Figure 88.

Operational interdependence layer structure for design libraries

system, such as core components and styles that are shared across the HCIS. The Shared Library builds upon the Core Library and includes reusable components and styles that are shared among multiple projects or teams within the HCIS. Lastly, the Local Library represents project-specific components and styles that are unique to a particular project or team within the HCIS and may override or extend the Core and Shared Libraries.

Core Library deliverables:

- Core components (e.g., buttons, icons, typography)
- Core styles (e.g., color palette, typography)

Shared Library deliverables:

- Reusable components (e.g., complex UI components)
- Shared styles (e.g., layout, spacing, form elements)

Local Library deliverables:

- Project-specific components (e.g., custom components)
- Local styles (e.g., project-specific styles, overrides)

Local libraries normally produce specific solutions that can be injected back into the Core or Shared Libraries following processes represented in *HCIS contributor flow* depicted in Figure 14.

9.7.3. CORE LIBRARY COMPONENTS AND DOCUMENTATION

Components are designed to be reusable and modular, following the principles of Atomic Design. These components are carefully crafted to provide consistent visual aesthetics, functional behaviors, and interaction patterns across the entire HCIS. They are designed to

be flexible and adaptable, allowing for customization and integration into different use cases and contexts.

The documentation accompanying the Core Library provides comprehensive guidance on how to effectively utilize and implement the components within the HCIS. It includes detailed specifications, usage guidelines, best practices, and code snippets, accessible from inspector panels or HCIS Central Repository (Website), for seamless integration into the HCIS development process. The documentation serves as a reference for designers, developers, and other stakeholders involved in the design and development of the HCIS, ensuring consistency, efficiency, and maintainability throughout the system.

Let's explore a component use case, a button, to expand this exposition.

9.7.3.1. BUTTON

A button is a graphical user interface (GUI) element that allows users to interact with a digital application or website by triggering an action or initiating a process when clicked or pressed.

9.7.3.2. OVERVIEW

The button serves as a functional link that connects various stages of a user flow, providing a cohesive and seamless experience for a specific use case. It can convey additional information, such as when user input is required (e.g., through

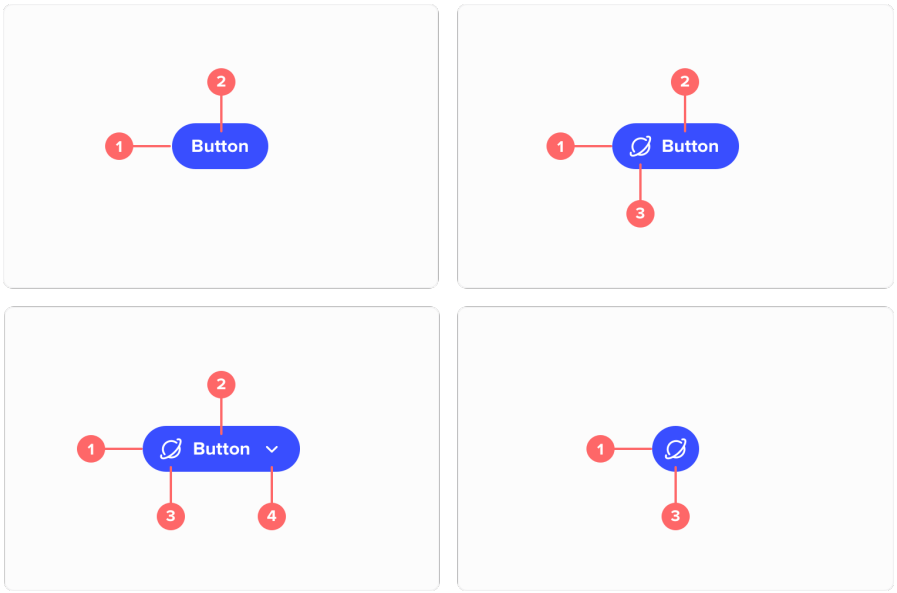


Figure 89.

Button anatomy

a disabled state waiting for user input), signal the completion of a user flow contract (e.g., a "Pay Now" or "Checkout" button), or indicate that the user is progressing through the flow by acknowledging presented information.

The button acts as a glue that binds the different elements of the user flow together, ensuring smooth navigation and interaction within the HCIS. It plays a vital role in facilitating user interactions, guiding users through the intended journey, and providing feedback on their progress. By leveraging appropriate button design and functionality, HCIS designers can optimize the user experience and enhance the overall usability of the system.

9.7.3.3. ANATOMY

Buttons are used to trigger actions. They contain a combination of labels and, if needed, an icon. An icon added to this component should not be used if a challenge can be solved without it.

Button:

1. Container
2. Text label (optional if we have icon)
3. Icon left (optional if we have text label)
4. Icon right (optional if we have text label)

This component is rendered in tree main formalizations: Filled, muted and ghost

9.7.3.4. FILLED BUTTON

Filled buttons serve as the optimal call-to-action (CTA) in user flows or content spaces.

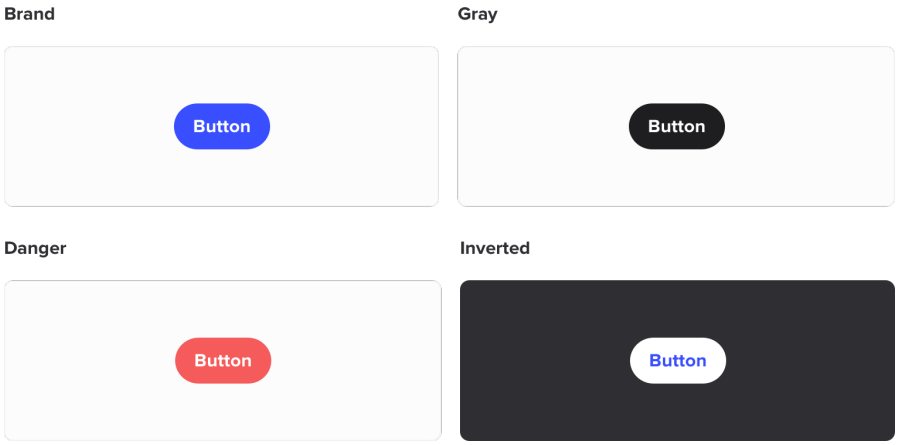


Figure 90.

Filled Button

They are strategically designed to prompt users to achieve their goals efficiently. Ideally, these buttons should be utilized sparingly, appearing only once within the viewport, and are not obligatory on every screen.

9.7.3.5. MUTED BUTTON

Muted buttons are specifically designed for form submissions or navigational actions. They are best utilized in menus or in conjunction with filter elements like tags and dropdowns. Their purpose is to play a supportive role and are typically used for less important actions in the user flow. These buttons are ideal for optional CTAs and actions that are not necessary for progressing through the main flow, such as "edit" or "view

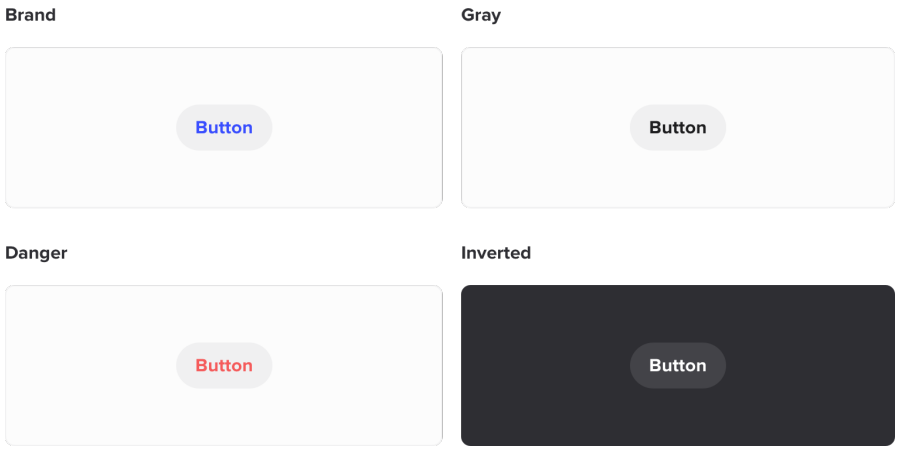


Figure 91.

Muted Button

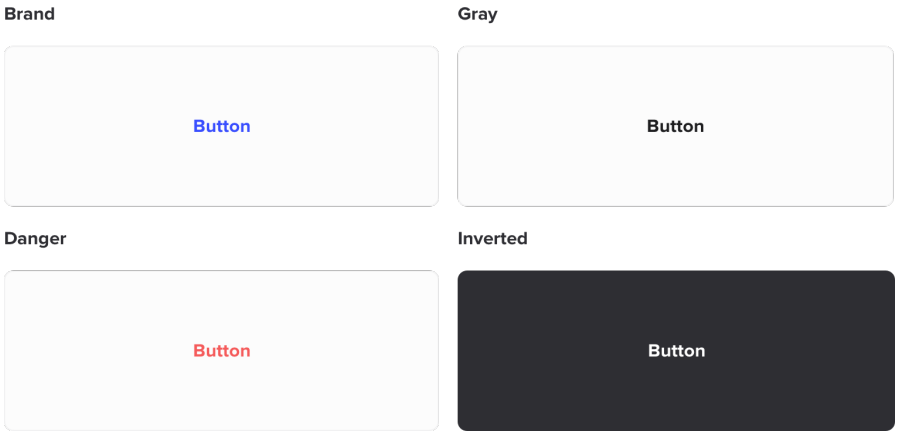


Figure 92.

Ghost Button

more", and should not be used for permanent actions like "add to cart" or "save".

9.7.3.6. GHOST BUTTON

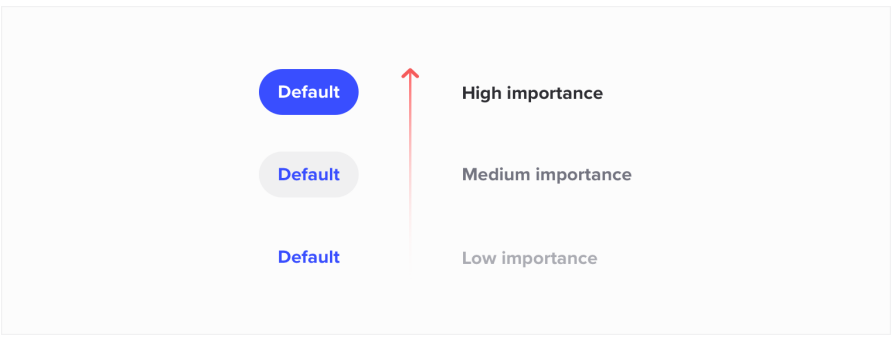
Ghost buttons are utilized as support buttons, such as for a dismiss CTA or actions of lower importance within the user flow objective or content space. They are not meant to be used on their own, but rather in conjunction with a filled or muted button, as a mandatory condition (with few possible exceptions).

9.7.3.7. HIERARCHY

A layout should prioritize a single button with high hierarchy, serving as the main CTA that guides the user towards their intended goal on the layout. However, it is also acceptable to have multiple buttons within the layout, with varying levels of importance. For instance, a high-importance button can coexist with medium and low-importance buttons, which perform less critical actions. This approach allows for flexibility in accommodating different levels of user interaction and action within the layout.

Figure 93.

Button Hierarchy



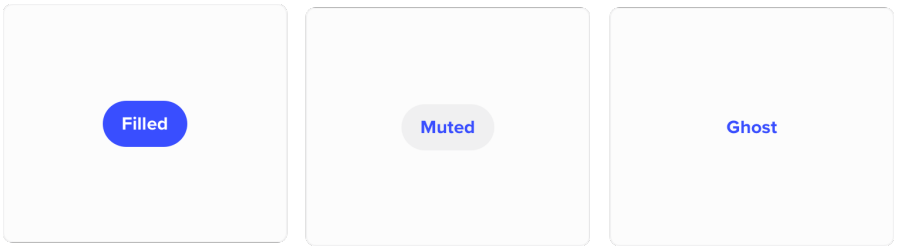


Figure 94.

Primary Button

In UX Design, the level of importance is crucial. The layouts should be meticulously crafted with the user's specific goals in mind, and the placement of CTAs plays a pivotal role in creating a seamless user journey. Importance is not solely determined by the type of button used, but also by its placement, size, and context within the layout. Careful consideration of all these factors is vital in creating an optimal user experience that aligns with the user's objectives and enhances their overall satisfaction with the interface.

9.7.3.8. BRAND — PRIMARY

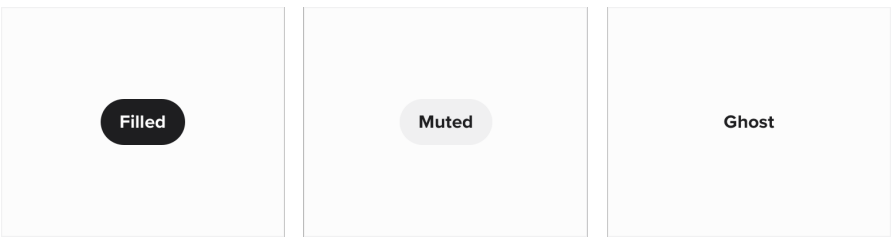
Used for primary actions and main flows. This style uses the primary brand color.

9.7.3.9. GRAY — SECONDARY

The Secondary button shares a similar style to the primary button, but it is intended for less critical, supportive actions. It is ideal for use in dashboards, lists, and non-payment related flows, where actions like compare, remove, or cancel may be required. However, it should not be used for permanent actions or cross-page flows. The Secondary button can be used in isolation or in conjunction with a primary button, depending on the desired user flow and interaction. Careful consideration should be given to ensure that the Secondary button is appropriately used for actions of lesser importance in order to create a cohesive and user-friendly interface.

Figure 95.

Secondary Button



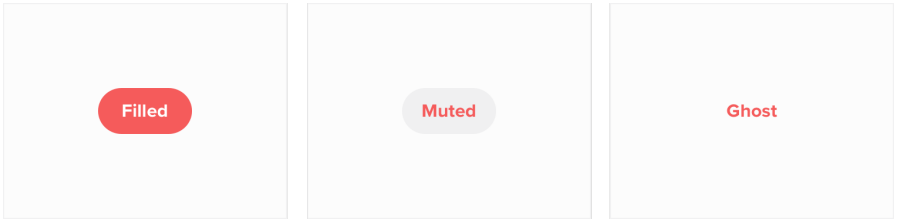


Figure 96.

Destructive Button

9.7.3.10. DANGER

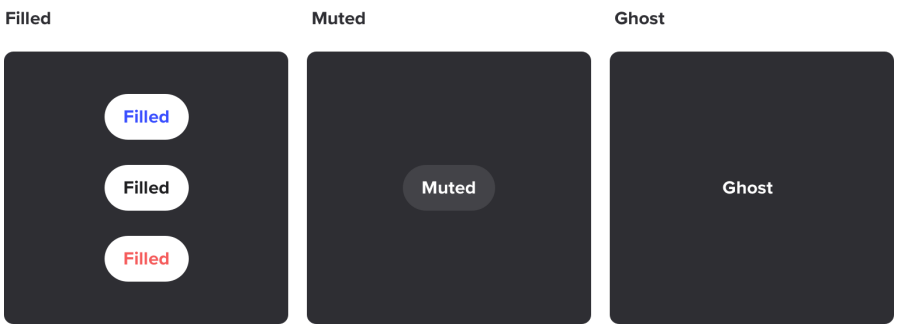
Notification colors can be strategically employed to reflect the intended result of an action. For instance, using a semantic red system colored button for delete actions can indicate a high-risk action. By utilizing appropriate colors in notifications, we can effectively convey the potential consequences or importance of an action to users. This visual cue can help users quickly understand the implications of their actions and make informed decisions, enhancing the overall usability and clarity of the interface.

9.7.3.11. INVERTED

The inverted variation of buttons is designed specifically for use on dark mode backgrounds or backgrounds with product colors, such as in footers and hero sections. They can also be utilized in page menus with either transparent or product-colored backgrounds. This variation of buttons is optimized for maximum visibility and legibility in darker or contrasting color contexts, ensuring that the buttons stand out prominently and provide a seamless user experience, even in different design elements of the interface.

Figure 97.

Inverted Button



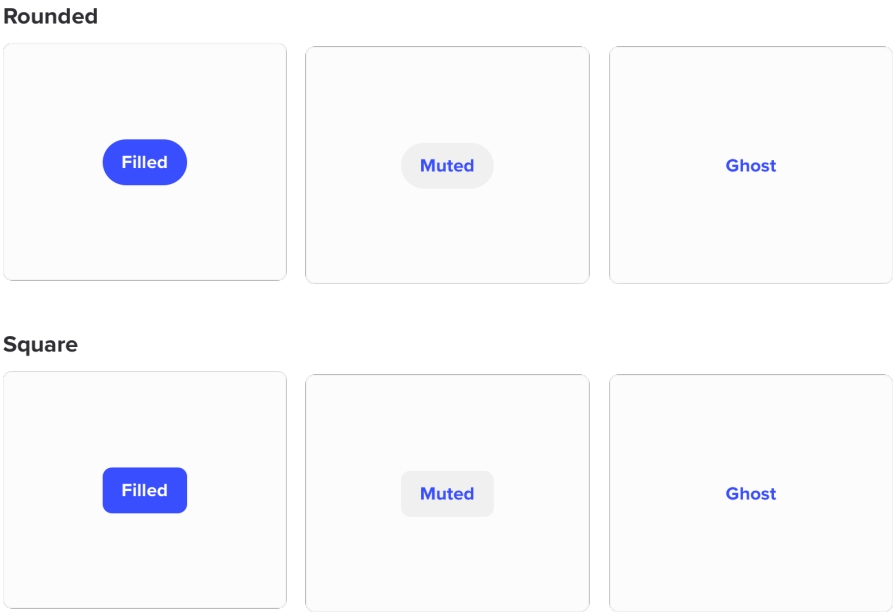


Figure 98.

Button Shapes

9.7.3.12. SHAPE

The buttons can be customized to have either a rounded shape or a square shape. Rounded buttons are generally used for most situations, providing a smooth and modern aesthetic. However, square buttons can be employed in cases where we need to achieve better alignment with other elements within a specific context or product. This allows for flexibility in adapting the button shape to harmonize with the overall layout and design elements, ensuring flexibility to extend the current toolkit to heterogeneous applications

9.7.3.13. SIZES

It's recommended using the big, default, and small button sizes as the default options for most situations. The extra small button size should only be used in cases where space is limited.

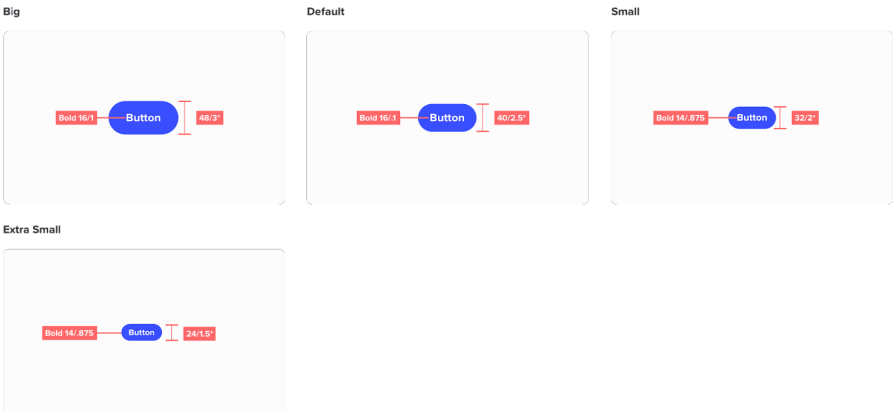


Figure 99.

Button Sizes

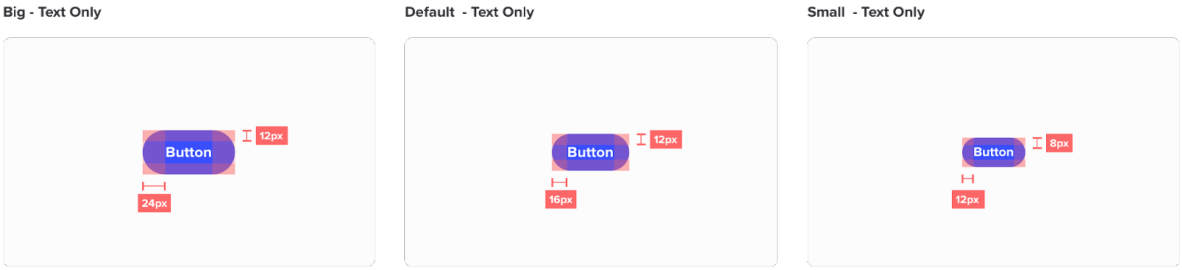


Figure 100.

Paddings

9.7.3.14. PADDING - DEVELOPMENT DOCUMENTATION EXAMPLE

Please consult Figure 100.

9.7.3.15. ALIGNMENT

As a general rule, it's recommended using center alignment for buttons by default. However, in specific cases where the button is used in conjunction with a dropdown or other related elements, left alignment can be used to ensure proper alignment and visual coherence within the interface.

9.7.3.16. BEHAVIOR

The behavior of a button refers to how it responds to user interactions and what actions it performs when clicked or activated. The behavior of a button can be defined through its functionality, interactivity, and visual cues, which collectively determine its purpose and how it functions within an interface. Here are some common behaviors of buttons:

Clickability: Buttons are designed to be clickable, allowing users to interact with them through various input methods such as mouse clicks or touch events.

Action: Buttons typically perform a specific action when clicked, such as submitting a form, navigating to a new page,

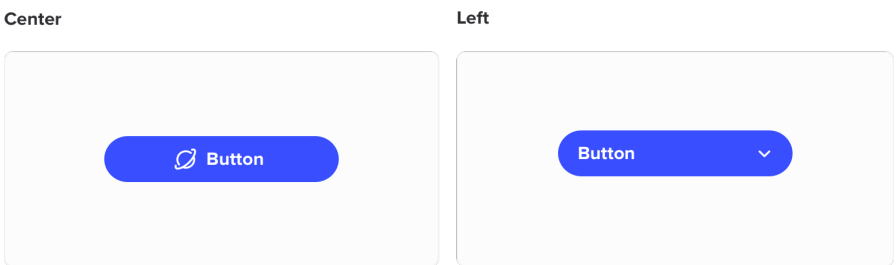


Figure 101.

Button alignments

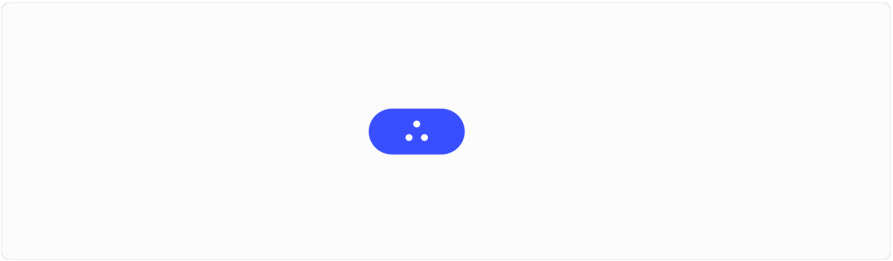


Figure 102.

Button loader

triggering a function or event, or initiating a transaction.

Feedback: Buttons may provide visual or auditory feedback to indicate that they have been activated, such as changing color, size, or shape, or playing a sound.

States: Buttons can have different states, such as default, hover, active, and disabled, which determine their appearance and behavior based on the user's interaction or the system's state.

Accessibility: Buttons should be designed to be accessible to all users, including those with disabilities, by providing appropriate keyboard navigation, focus indicators, and alternative text for screen readers.

9.7.3.17. LOADING

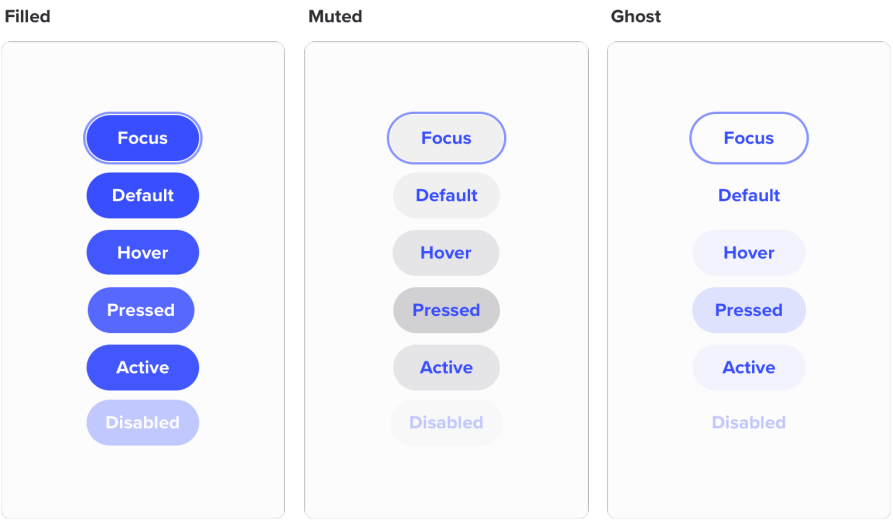
When needed the button will assume the state of loading and replace its content with a spinner to inform the user of the process.

9.7.3.18. STATES

Buttons are interactive elements, so they behave according to the interaction the user performs.

Figure 103.

Button States Light



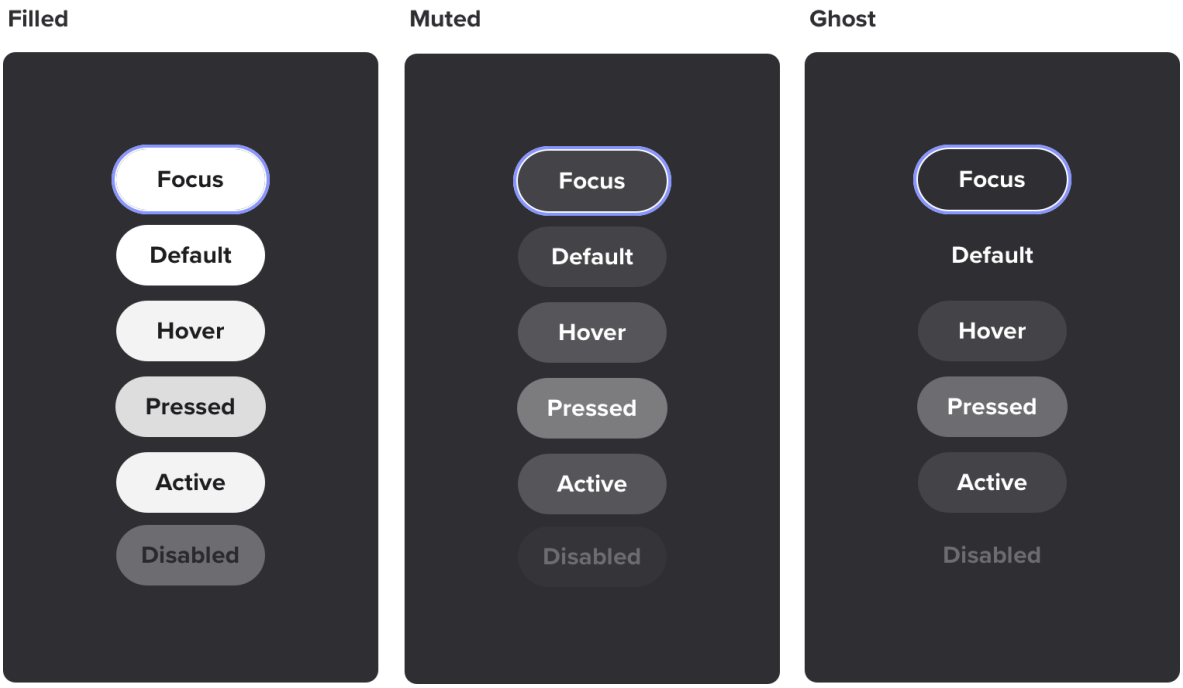


Figure 104.

Button States Dark

9.7.3.19. DROP DOWN — DEVELOPMENT DOCUMENTATION EXAMPLE

Please consult Figure 104.

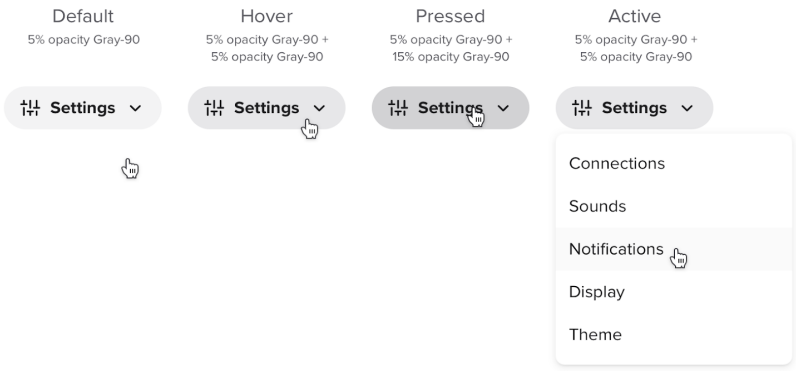


Figure 105.

Dropdown States

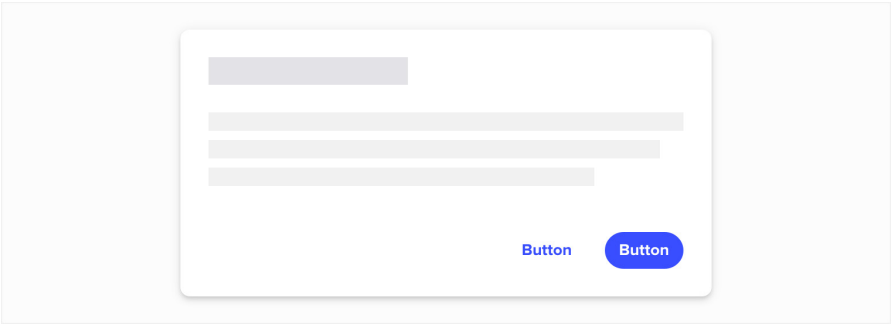
9.7.3.20. USAGE

The width of the button is determined by the content, however, if necessary there's the option of using grid width making the button a block component.

9.7.3.21. DYNAMIC BUTTONS

Figure 106.

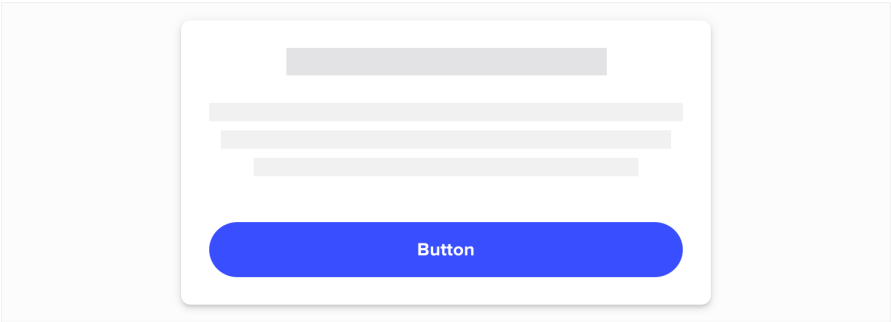
Dynamic Button



9.7.3.22. BLOCK BUTTONS

Figure 107.

Block Button



9.7.3.23. PATTERNS

9.7.3.24. Z PATTERN

The Z-pattern is a user-friendly approach for guiding users through content within a confined container, with tasks typically oriented from the top-left corner and culminating with a primary call-to-action button at the bottom-right corner of the container. For interfaces that are designed for left-to-right languages, this pattern is commonly followed. However,

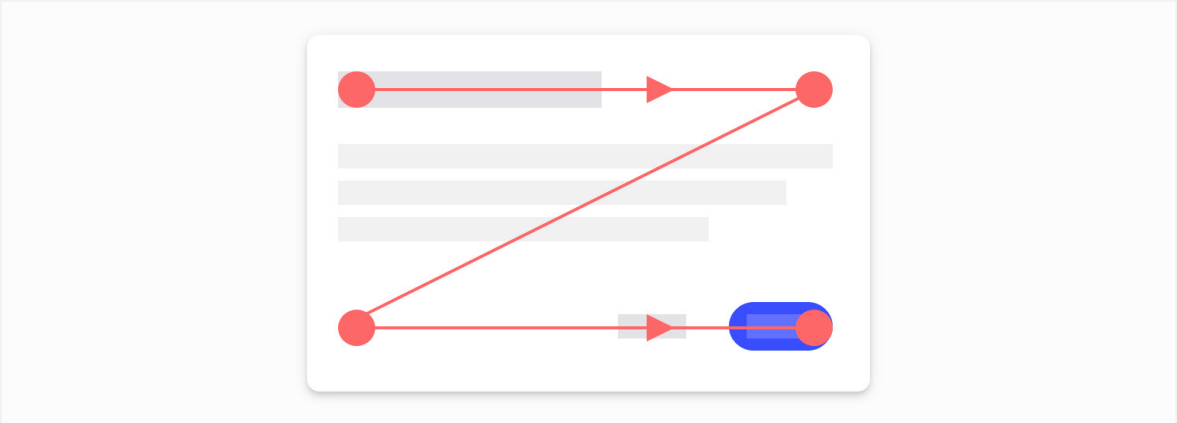


Figure 108.

Z Pattern

for interfaces that are designed for right-to-left languages, the Z-pattern is often reversed to accommodate the reading direction. Adhering to the Z-pattern in interface design can help create a smooth and intuitive user flow, leading up to a clear and prominent call-to-action for their intended tasks.

Ex. Cards, modals and messages.

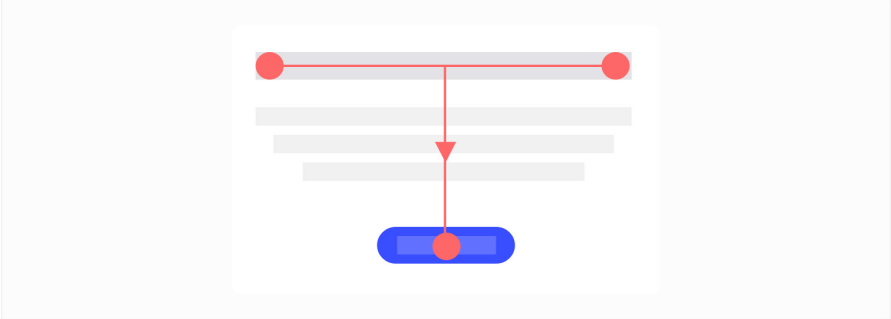
9.7.3.25. T PATTERN

The T-pattern is a commonly used approach for presenting information in a call-to-action form, typically employed in media objects and other relevant sections of product pages. This pattern is characterized by placing the call-to-action button at the top of a vertical column, followed by a brief description or supporting information below it, creating a T-shape layout. This layout allows users to quickly scan the information and engage with the call-to-action button in a visually prominent and easily accessible manner. By leveraging the T-pattern in interface design, product pages can effectively highlight key calls-to-action, driving user engagement and facilitating efficient interaction with the displayed information.

Ex. Media objects and some relevant comparison cards.

Figure 109.

T Pattern



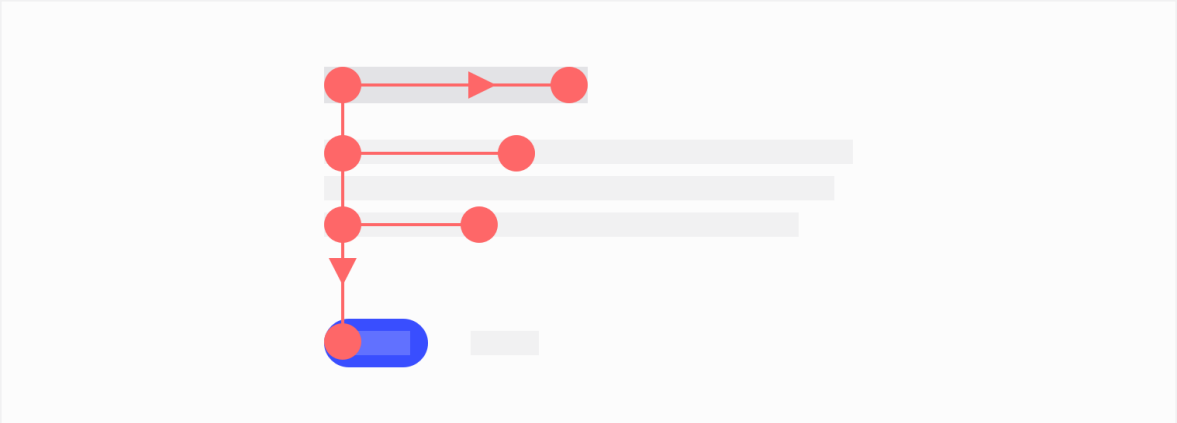


Figure 110.

F Pattern

9.7.3.26. F PATTERN

The F-pattern is an intuitive approach for users to navigate through content within an unconstrained container, such as a form displayed directly on the page. Users tend to follow an F-shaped pattern, scanning the content horizontally across the top of the container and then moving vertically down the left-hand side, forming the shape of an F. This pattern allows users to quickly process the content in a linear fashion, typically reading the headlines and important information first, before arriving at a call-to-action button at the end of the content. By incorporating the F-pattern in interface design, forms and other content-heavy sections can be optimized for user engagement, ensuring that important information and call-to-actions are strategically placed to enhance user experience and drive desired actions.

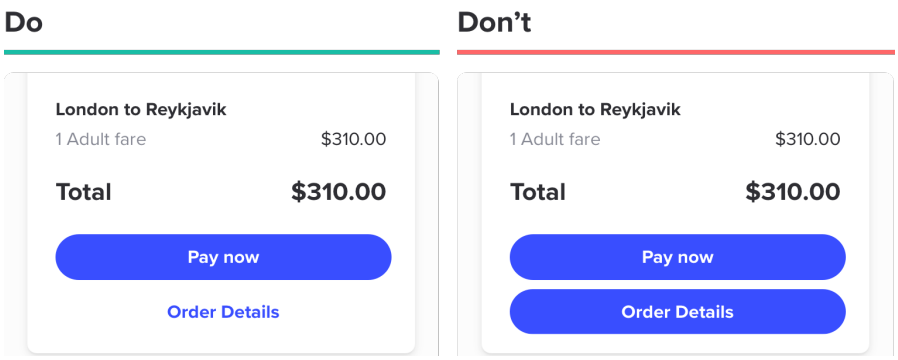
Ex. Media objects, Heroes, and other texts.

9.7.3.27. DOS AND DON'TS — EXAMPLE

Do: Use a filled button to make a clear main CTA and a ghost below or besides the filled to call for a secondary action.

Figure 111.

Button Guidance



color_primary_50	#394eff
#394eff	16px
font_size_large	16px
16px	4px
spacing_medium	0px 4px 6px rgba(0, 0, 0, 0.1)

Figure 112.

Design token attributes example

Don't: Avoid using filled buttons next to each other, specially when there're they recall for actions with different importance for the user.

9.8. DESIGN TOKENS

Design tokens are a form of digital abstraction that encapsulate visual and design-related properties, such as colors, typography, spacing, and other design attributes, into reusable, semantic, and maintainable units. They provide a single source of truth for design decisions, making it easier to manage and maintain consistent design across different platforms, devices, and applications.

Design tokens are typically used in conjunction with a design system to provide a systematic way of defining and applying visual styles, and other design properties.

A token structure is a defined hierarchy or organization of design tokens that reflects the structure and components of a design system.

These design token attributes represent a primary color, font size, spacing, border radius, and shadow, respectively. These values can be used consistently throughout a HCIS, allowing for easy updates and maintenance, and ensuring visual consistency across multiple sources of truth and cross-platforms.

9.9. INTERDEPENDENCIES AND PROPAGATION

9.9.1. ATOMIC LEVEL

Abstraction containers are essential conceptual tools to address interdependencies and multiple ownership requirements used in software engineering and design to promote modularity, reusability, and maintainability of software systems. They provide a structured approach to designing complex systems by encapsulating core, shared, and local components within abstracted containers, which can be easily manipulated and reused

across different parts of a system or even across different systems. In this context, core components represent the fundamental building blocks of a system, shared components are components that are used by multiple parts of the system, and local components are components that are specific to a particular part of the system.

Core components are the foundational elements of such a system and are typically abstracted into reusable containers to facilitate their management and maintenance. These components form the basis of the system's architecture and provide a high-level overview of its structure and functionality. By encapsulating core components within abstraction containers, changes or updates to these components can be managed in a modular way, allowing for easier maintenance and evolution of the system over time.

Shared components are components that are used by multiple parts of the system and are abstracted into containers to promote code reuse and consistency across the system, therefore across multiple design and engineering teams. These components are typically generic and reusable, providing common functionality that is used by different modules or subsystems of the system. Examples of shared components include utility functions, shared combo UI components, and communication interfaces. By abstracting shared components into containers, they can be easily consumed, updated or replaced in a centralized or decentralized manner, ensuring consistency and coherence across the system.

Local components are components that are specific to a particular part of the system or team and are encapsulated within abstraction containers to provide encapsulation and isolation or just used in particular contexts in isolation. These components are

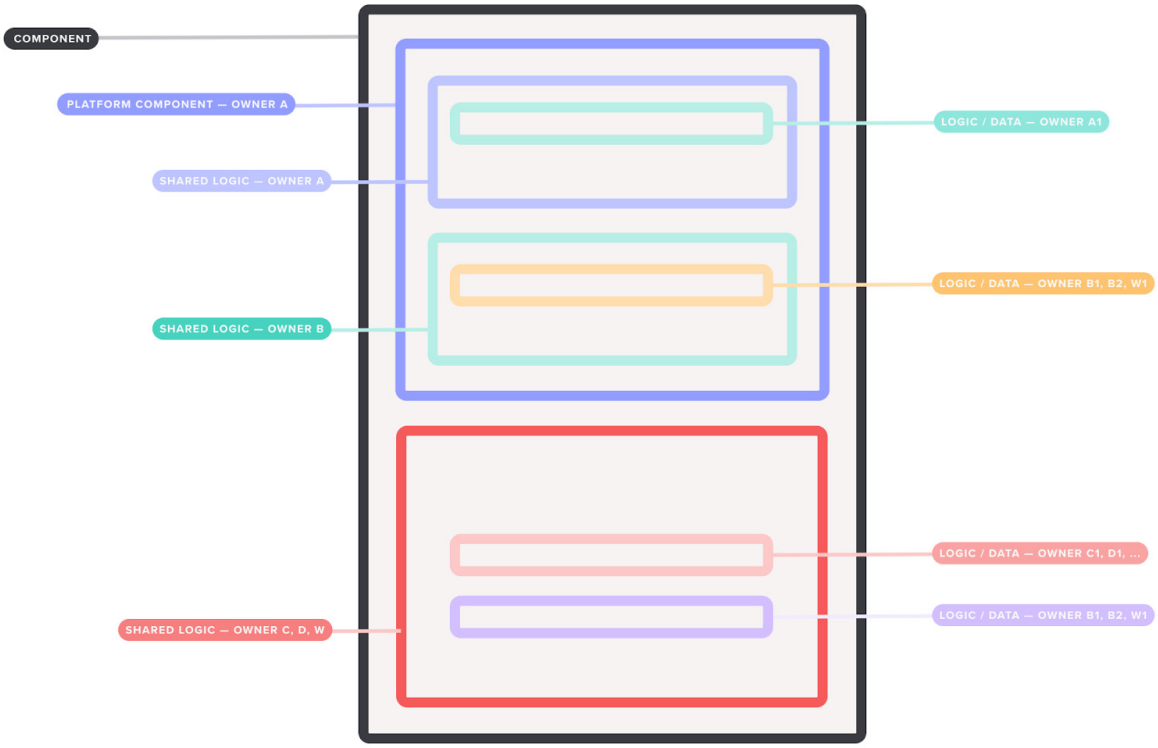


Figure 113.

Shared Component Architecture

typically tailored to the specific requirements of a particular team, module or subsystem and are not intended for use by other parts of the system. They are often labeled as snowflakes due their exceptional nature. Examples of local components include module-specific algorithms, configuration settings, and UI components that are only used in a particular part of the system or product. By abstracting local components within containers, they are kept isolated from the rest of the system, minimizing dependencies and promoting encapsulation, which can improve the maintainability and stability of the system.

Constant monitoring and active communication channels identify such isolated and local patterns to be classified and possibly injected in the core libraries for general and systemized consumption.

Interdependencies between abstraction containers are managed through well-defined touchpoints that specify how different component abstractions interact with each other. These interfaces serve as the communication channels between components, allowing them to exchange data and invoke functionality in a controlled and standardized manner.

Figure 113, represents a use case where a component can encapsulate multiple library

interdependent hierarchies, multiple teams ownership and incorporate business logic from separate business units.

9.9.2. TEMPLATE LEVEL

At the template level, the focus is on creating abstraction containers for larger groups of components, such as atoms, molecules, and organisms. These abstraction containers serve as building blocks that can be assembled into sections or blocks.

Sections are created with careful consideration of the context and logic provided by multiple teams, taking into account their input and usage. The sequence of these sections is determined with a specific goal in mind, such as showcasing a product's unique features and benefits for the user or addressing a particular functional or emotional goal.

The process of assembling sections involves bringing together different components, such as atoms (basic design elements), molecules (combinations of atoms), and organisms (complex components made up of molecules and atoms). These components are organized and structured in a way that best serves the intended purpose of the template.

The context and logic provided by various teams, such as design, development, and marketing, are carefully considered to ensure that the template is effective in achieving its goal. This may involve creating visual hierarchies, defining interactions, and incorporating relevant content to create a cohesive and meaningful user experience.

The template level is where the design and functionality of the interface or product come together, creating a unified and coherent whole. It involves collaborative efforts from multiple teams, each contributing their expertise to create a template that is visually appealing, functional, and aligned with the overall

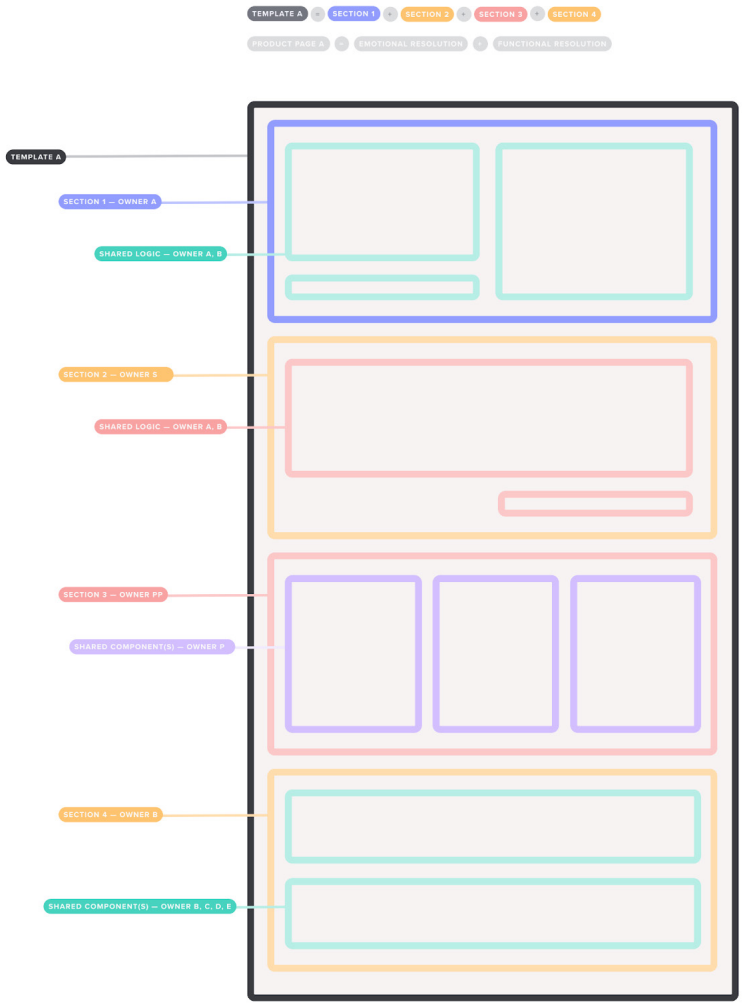


Figure 114.

Template abstraction layers interdependencies

product or brand strategy. The goal is to create a template that can be easily reused and adapted across different sections or blocks, providing consistency and efficiency in the design and development process.

9.10. SINGLE SOURCE OF TRUTH

Single Source of Truth (SSoT) in the context of HCISs is "the single point of reference for all design and development decisions and documentation".[182] According to Kholmatova, a SSoT helps designers and developers maintain consistency and coherence in their work, which is essential for creating effective and efficient HCISs.

Rowland et al.[183] suggest that the SSoT should be a central repository for all project-related information, including design specifications, requirements, and user research findings. This repository should be accessible to all stakeholders, including designers, developers, and project managers. They also stress the importance of version control and access management processes to ensure that everyone has access to the correct and most up-to-date information.

However, in the scope of Global Design Systems, which involve multiple complex and multidisciplinary development streams, it may be fundamental

182. Kholmatova, Alla. 2017. Design Systems. Edited by Smashing Magazine. Smashing Media AG.P.60

183. Rowland, Claire, Elizabeth Goodman, Martin Charlier, Ann Light, and Alfred Lui. 2015. Designing Connected Products: UX for the Consumer Internet of Things.

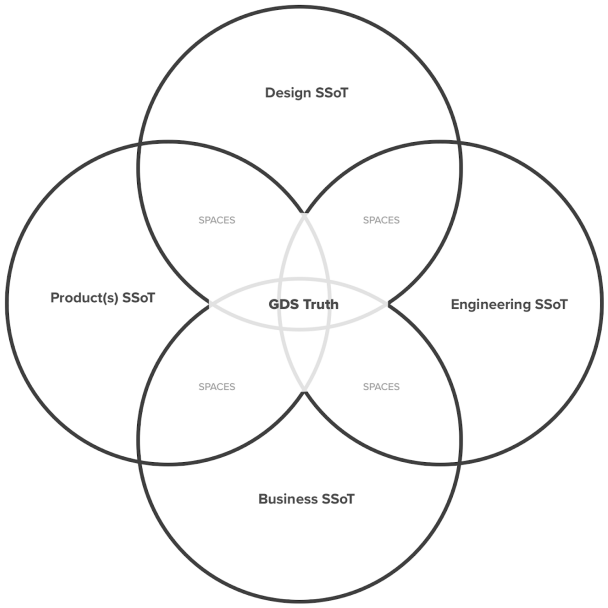


Figure 115.

Global Design System Multiple Source of Truth

to shift from a single SSoT to multiple SSoTs. This approach helps designers and developers leverage the unique perspectives and approaches of different fields to create a more cohesive and comprehensive design system. Each SSoT should have clear boundaries and intersection protocols to exchange information about the latest state of truth. Having multiple SSoTs can improve consistency, reduce the risk of inconsistencies, and better manage the volume and complexity of information, ultimately leading to a more efficient and effective global design system.

Spaces or "dynamic repositories", are a potential additional step to atomic design methodology proposed in this body of work, focused on linking multiple SSoT from creative and development streams. *Spaces* theory can be utilized to create designated spaces or repositories that serve as centralized sources of truth for design and engineering artifacts, documentation, and other relevant resources.

One example of such a space could be the HCIS website, which acts as a primary source of truth for design and engineering guidelines and best practices. This website contains comprehensive documentation and resources that are regularly updated and maintained to ensure accuracy and consistency. By having a single source of truth on the HCIS website, core teams and satellite teams can access the most up-to-date information, facilitating cross-communication and alignment across the organization.

Furthermore, spaces theory can be applied to orchestrate design and engineering artifacts and documentation across different platforms or repositories. For instance, project management tools, collaborative platforms, or document repositories can be used

as shared spaces where teams can collaborate, share updates, and provide feedback on design and engineering efforts. These spaces enable cross-team communication and coordination, promoting a cohesive and unified approach to design and development.

In addition to the HCIS website, other spaces, such as the brand design website, can also be utilized to create and maintain more touch points between teams. For example, the brand design website can serve as a platform for sharing brand guidelines, visual assets, and other design-related resources, ensuring consistency in branding across the organization.

By incorporating the concept of spaces theory into the atomic design methodology, organizations can establish a structured approach to link and maintain single sources of truth from multiple platforms or websites. This facilitates efficient cross-communication between core teams and satellite teams, promotes consistency in design and engineering efforts, and enables effective collaboration and coordination across stakeholders and the organization as a whole.

9.10.1. INFRASTRUCTURE — EXAMPLE

The HCIS website is a digital platform that converges design and engineering artifacts, documentation, and provides clear guidance. This convergence is made possible by linking to design tools and serving NPM packages and dedicated programming languages, which enable users to access and utilize resources efficiently.

From a technical standpoint, the HCIS website serves as a centralized hub for various design and engineering resources, such as style guides, code snippets, UI components, and other design assets. The website is designed to facilitate easy navigation and access to these resources, with features such as search

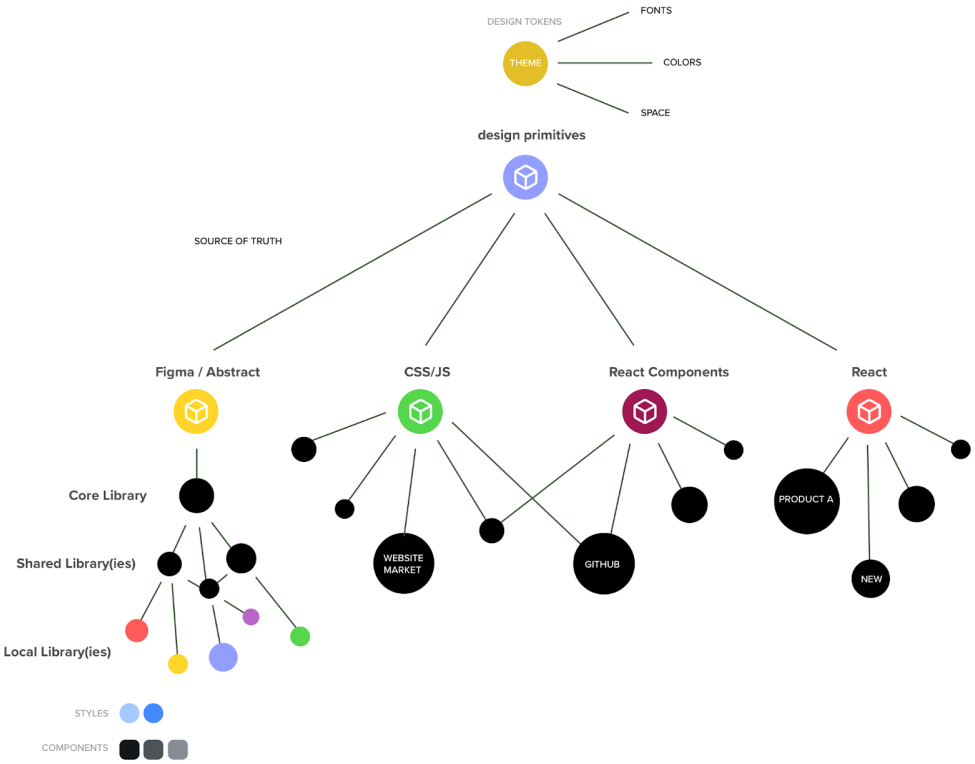


Figure 116.

Source of truth HCIS

functionality, hierarchical organization, and clear labeling.

One key aspect of the HCIS website's technical infrastructure is its ability to serve NPM packages and dedicated programming languages. NPM[184] (Node Package Manager) is a package manager for the JavaScript programming language that allows developers to share and reuse code modules. By serving NPM packages, the HCIS website enables developers to easily integrate existing code modules into their projects, saving time and effort in the development process.

In addition to NPM packages, the HCIS website also provides access to dedicated programming languages, such as CSS, HTML, and JavaScript. These languages are essential for web development, and the website provides resources and guidance on how to use them effectively.

Another critical aspect of the HCIS website's technical infrastructure is its ability to link to design tools. These design tools can include wireframing software, prototyping tools, and graphic design software, among others. By linking to these tools, the website enables designers and developers to access the tools they need to create and iterate on designs efficiently.

Furthermore, the HCIS website is designed to converge design and engineering artifacts, documentation, and guidance, making it an essential resource for cross-functional teams. The website's technical infrastructure is built to facilitate easy navigation and access to these resources, ensuring that teams can access the information they need to

184. "Npm." n.d. Accessed April 18, 2023. https://www.npmjs.com/.

collaborate effectively and produce high-quality work.

A possible interpretation of an HCIS source of truth interdependencies is depicted in Figure 115.

9.11. CONCLUSIONS

It's fundamental to emphasize the importance of acknowledging the multiplicity of sources of truth in the development of work in creative ecosystems, as highlighted in this dissertation. The spaces theory proposed in the text reinforces this necessity by recognizing that different fields and domains have unique perspectives and approaches, which can result in different sources of truth.

In Global Design Systems (GDSs), it is crucial to recognize the multiplicity of single sources of truth and to converge this information in ways that are accessible to all members of the creative ecosystem. By doing so, designers, developers and all contributors can leverage the unique perspectives and approaches of different fields to create a more cohesive and effective design system.

Moreover, this dissertation introduces the notion of a Global Design System that recognizes the multiplicity of sources of truth and converges information in orchestrated, systemic, and accessible ways. The spaces theory proposed in the text reinforces this notion by highlighting the value of incorporating different perspectives and approaches in the development of work through dedicated frameworks for shared context and shared ownership, as well as providing real-time collaboration tools through methodologies of metadesign.

This dissertation contributes to the field of design by highlighting the importance of acknowledging the multiplicity of sources of truth, proposing a Global Design System that recognizes this multiplicity and converges information in

accessible ways, and introducing spaces theory as a means of converging and incorporating different perspectives and approaches in the development of work by creating the necessary intersections of fields and context maintaining clear boundaries of expertises.

10. FURTHER CONSIDERATIONS

10.1. ARTIFICIAL INTELLIGENCE

As this work is being produced, vast amounts of data is being generated by Artificial Intelligence (AI). This emergent technology is reshaping digital and physical landscapes. The impact that will be produced in communication is unprecedented.

In context of this work, I've proposed, implicitly, a human supervision of metadesign methodologies that are explored through multiple frameworks. I would, therefore, propose further research on non-supervised models to achieve self-sustainable ecosystems, sources of truth, to achieve optimal and intelligent production flows. Humans, in such a scenario, would be data input and outcome designers.

The role of AI in Human-Computer Interaction systems in such scenarios can be broadly described in the following steps:

Data Collection: AI-powered HCISs rely on data to understand user behaviors, preferences, and interactions. Data can be collected through various means, such as sensors, user inputs, and browsing history.

Data Processing: Once the data is collected, AI algorithms process and analyze it to extract meaningful insights. This may involve techniques such as natural language processing, computer vision, and machine learning to understand user intents, emotions, and interactions.

User Modeling: Based on the processed data, AI models create user profiles or models that capture user preferences, behaviors, and other relevant information. These models are

continuously updated as new data becomes available.

Personalization: AI in HCISs uses the user models to personalize the interactions and experiences for individual users. This may include personalized recommendations, content adaptation, and tailored interfaces to meet the unique needs and preferences of each user.

Adaptive Interaction: AI-powered HCISs adapt and optimize interactions based on user feedback and contextual information. This may involve adjusting interface layouts, changing interaction patterns, or dynamically updating content to provide the best user experience.

Accessibility: AI technologies are also used to improve accessibility in HCISs, making them more inclusive for users with disabilities. This may include features such as voice commands, gesture-based interactions, and real-time captioning for users with visual or hearing impairments.

Contextual Understanding: AI in HCISs can also interpret and understand the contextual information, such as location, time, and social context, to provide more relevant and timely interactions.

Continuous Learning: These systems are capable of continuous learning and improving based on user feedback and evolving user preferences. This allows for ongoing refinement of the system's performance and capabilities.

Feedback and Evaluation: They may also collect feedback from users to evaluate the effectiveness of the system and identify areas for improvement.

Ethical Considerations: Finally, the role of AI in such systems also includes ethical considerations, such as ensuring user privacy, transparency in AI decision-making, and addressing potential biases in data and algorithms.

AI should plays a significant role in HCISs, encompassing data collection, processing,

user modeling, personalization, adaptive interaction, accessibility, contextual understanding, continuous learning, feedback and evaluation, and ethical considerations. These steps collectively contribute to creating more intelligent, personalized, and user-centric interactions between humans and computers.

There are significant implications for global design systems. AI-powered design tools and technologies can enhance the user experience, increase efficiency, ensure consistency, adapt to different contexts, enable rapid prototyping and iteration, inform data-driven design decisions, raise ethical considerations, enhance collaboration, and improve scalability and flexibility. However, it is crucial for designers to be mindful of ethical implications, potential biases, and the responsible use of AI in design processes to ensure user-centric and culturally appropriate design solutions.

10.1.1. EMERGENT ABILITIES

The recent and notorious advancements on the field of artificial intelligence evoques a new industrial revolution paralleled paradigm shift.

Emergent Abilities of Large Language Models[185] explores the remarkable capabilities exhibited by advanced language models like GPT-4,[186] which demonstrate proficiency in various tasks such as translation, summarization, question-answering, and basic programming. The authors attribute these abilities to the models' extensive training on diverse and large-scale data, which enables them to learn complex patterns and solve a wide range of tasks without explicit supervision or fine-tuning. This research underscores the potential of large language models in revolutionizing natural language processing and artificial intelligence applications,

185. Wei, Jason, Yi Tay, Rishi Bommasani, Colin Raffel, Barret Zoph, Sebastian Borgeaud, Dani Yogatama, et al. 2022. "Emergent Abilities of Large Language Models."

186. "GPT-4." n.d. Accessed May 9, 2023. https://openai.com/research/gpt-4.

while also highlighting the challenges and ethical concerns surrounding their development and deployment.

While this text explores a human supervised reality in the construction and supervision of these systems, we'll propose further work moving beyond this assumption. Therefore, a non-supervised AI can propose the architecture of such environments.

The idea of non-supervised AI proposing the architecture of Global Design Systems represents a significant departure from traditional design methods, which rely on human supervision and input throughout the design process. By leveraging the power of AI to generate new ideas and solutions, designers can potentially explore a wider range of possibilities and create more innovative and optimal solutions.

To enable such a possibility of a non-supervised AI entity for GDSs one must approach the concept of Artificial General Intelligence (AGI). AGI will represent a radical paradigm shift, not only in the context of Global Design Systems but rather to the entire technology industry with a clear impact on contemporary society. AGI refers to highly autonomous systems or machines that possess the ability to understand, learn, and perform intellectual tasks at a level equal to or surpassing that of human intelligence. Unlike specialized AI systems that are designed to perform specific tasks, AGI aims to exhibit a broad range of cognitive abilities and adaptability across different domains. Some of these recent breakthroughs can be read in the paper, from the Microsoft Artificial Intelligence research team led by Sébastien Bubeck: *Sparks of Artificial General Intelligence: Early experiments with GPT-4*.[187]

However, the non-supervised use of AI in design also raises important ethical considerations, particularly in the context of global design systems that have

187. Bubeck, Sebastien, Varun Chandrasekaran, Ronen Eldan, Johannes Gehrke, Eric Horvitz, Ece Kamar, Peter Lee, et al. n.d. "Sparks of Artificial General Intelligence: Early Experiments with GPT-4."

This "decision making" side of innovation is what scholars and practitioners refer to as "design." Decisions in innovation processes have so far been taken by humans. What happens when they can be substituted by machines?[188]

"The future of design is a synthesis of human creativity and artificial intelligence."[189]

significant social, economic, and environmental impacts.

The impact of such a possible approach to apply non-supervised models should lead to further extensive research in this field of development.

This quote highlights the potential of non-supervised AI to augment human creativity and enable designers to create more innovative and effective solutions. However, as noted by Maeda, this future will require a collaboration between humans and machines, with designers and innovators leveraging the power of AI to create solutions that are aligned with user needs and preferences.

10.2. FUTURE INTERFACES

In this section we'll speculate, briefly, about the future of communication, user interface and experience. From this brief ideation we should outline emergent challenges that Global Design Systems should prepare for and above all to proactively start designing for scenarios that are close in the horizon.

The future of interfaces holds exciting possibilities as technology continues to advance. One emerging trend is the shift towards edge computing,[190] which involves processing data closer to the source rather than relying solely on centralized cloud computing.[191] This shift is closely linked to Moore's Law,[192] which states that the processing power of computers doubles approximately every two years.

The integration of Moore's Law and edge computing has the potential to transform various sectors, including healthcare, transportation, and entertainment.

188. Verganti, Roberto, Luca Vendraminelli, and Marco Iansiti. 2020. "Innovation and Design in the Age of Artificial Intelligence." Journal of Product Innovation Management 37 (3): 212–27.

189. Maeda, John. 2019. How to Speak Machine: Computational Thinking for the Rest of Us.

190. Cao, Keyan, Yefan Liu, Gongjie Meng, and Qimeng Sun. 2020. "An Overview on Edge Computing Research." IEEE Access 8: 85714–28.

191. Shi, Weisong, Jie Cao, Quan Zhang, Youhuizi Li, and Lanyu Xu. 2016. "Edge Computing: Vision and Challenges." IEEE Internet of Things Journal 3 (5): 637–46.

192. Schaller, R.R. 1997. "Moore's Law: Past, Present and Future." IEEE Spectrum 34 (6): 52–59.

The proliferation of IoT devices and the adoption of Industry 4.0[193] will further drive this evolution.[194]

From possible extrapolations of the relationship between Moore's Law and edge computing in this context of future interfaces one can explore the following triggers that can fuel the development of such interfaces:

Increased Processing Power: Moore's Law predicts that processing power will continue to increase exponentially. This allows edge devices, such as smartphones, wearables, and Internet of Things (IoT) devices, to perform complex computations and run sophisticated algorithms locally. As a result, future interfaces can leverage this increased processing power to deliver seamless and responsive user experiences.

Real-Time Interactions: Edge computing enables future interfaces to deliver real-time interactions by reducing latency. With processing power approaching that of traditional servers, edge devices can analyze and respond to user input without relying heavily on cloud-based servers. This results in faster response times and a more immediate and immersive user experience.

Enhanced Privacy and Security: Edge computing minimizes the need to transmit sensitive data to the cloud, reducing privacy and security risks. Future interfaces can leverage local processing capabilities to perform data analysis and execute complex tasks while keeping personal information securely stored on the edge devices. This approach enhances user privacy and reduces vulnerability to data breaches.

Offline Functionality: With edge computing, future interfaces can operate offline or with limited connectivity. By leveraging local processing power, edge devices can continue to provide essential functionalities and maintain a seamless user experience even in

193. Lasi, Heiner, Peter Fettke, Hans-Georg Kemper, Thomas Feld, and Michael Hoffmann. 2014. "Industry 4.0." Business & Information Systems Engineering 6 (4): 239–42.

194. Mourtzis, D., E. Vlachou, and N. Milas. 2016. "Industrial Big Data as a Result of IoT Adoption in Manufacturing." Procedia CIRP, 5th CIRP Global Web Conference - Research and Innovation for Future Production (CIRPe 2016), 55.

environments with intermittent or no internet connectivity. This capability is particularly important in remote areas or during network disruptions.

Edge-AI Integration: The combination of Moore's Law and edge computing opens up opportunities for integrating AI capabilities directly into edge devices. Future interfaces can leverage on-device machine learning models and algorithms to provide personalized recommendations, intelligent automation, and predictive capabilities without relying heavily on cloud resources. This integration of AI at the edge enables efficient and autonomous decision-making, making interfaces smarter and more adaptive.

Scalability and Flexibility: Edge computing allows future interfaces to scale and adapt to dynamic network conditions and user demands. As the number of edge devices continues to grow, the distributed nature of edge computing enables efficient load balancing, reducing the strain on centralized servers. This scalability and flexibility ensure consistent performance and responsiveness across a wide range of devices and network environments.

Digital Ownership: There will be a greater emphasis on ownership, giving users more control over their digital experiences and assets. With increased concerns about data privacy and security, users will demand interfaces that provide transparency and allow them to have ownership and control over their personal data. Future interfaces should empower users with the ability to manage their data and decide how it is used, creating a sense of trust and ownership in the digital realm.

Form follows emotion

— Hartmut Esslinger

Hyper Customization: Future interfaces will enable hyper customization, allowing users to personalize and tailor their experiences to a granular level. Through advanced customization options, users will have the ability to configure interfaces according to their preferences, styles, and specific needs. This hyper customization can encompass visual elements, interaction patterns, content preferences, and more. By providing such customization capabilities, interfaces will become more adaptive and cater to individual user preferences, resulting in highly personalized and satisfying user experiences.

From the following assumptions let's explore some possible applications.

10.2.1. PERCEPTIVE INTERFACES

The design principle "form follows function" emerged in the early 20th century and was attributed to American architect Louis Henry Sullivan (1856-1924). This principle suggests that a product's functional and optimal form is inherently derived from its purpose. As a result, this principle often leads to the creation of minimalist and purely functional products. However, Sullivan believed that additional elements, such as ornamentation on buildings, could serve a purpose, such as enhancing their representativeness.

On the other hand, "form follows emotion" is a design approach developed by German-American designer Hartmut Esslinger (*1944), the founder of frogdesign. During the 1980s, Esslinger criticized the burgeoning high-tech industry for producing mass-market products that resembled mere technical instruments. Instead, he sought to make the appearance and, more importantly, the user experience of such products emotionally engaging and *sensually* charged. Esslinger aimed to shape the

People don't just receive feedback haptically, but above all emotionally[197]

relationship between people and devices, making technical products more accessible to users. This design philosophy led to his collaboration with Apple in 1982 and the subsequent introduction of the Apple IIc[195] in 1984. Featuring the iconic Snow White design[196] the Apple IIc has become a product archetype that has inspired generations of designers.

Emotion should trigger a new generation of interfaces. Emotions should be seen as an outcome of a *sensorial* process where an interface is positioned in the middle and bridges action and intention.

Attributes such as artificial emotional intelligence (AEI), can generate algorithmic engines for such resolutions and create systems that are empathetic and highly predictive while maintaining clear etic and privacy boundaries between user and interface. Such boundaries should be at the core design for such interface architecture and multiple fields of development, beyond visual, should be explored, including audio and physiological signal processing.

Affective computing[198] casts some light on the topic, as it involves the development of systems that can recognize, interpret, and respond to human emotions. Researchers in this field can contribute to building interfaces with AEI by developing algorithms and techniques that allow systems to process emotional cues from users, such as facial expressions, speech patterns, or physiological signals.

10.3. NEOTERIC INTERFACES

Unlike conventional graphical user interfaces (GUIs) that primarily rely on mouse/touch and keyboard inputs that use screens to *frame* these inputs, neoteric interfaces introduce

195. "Apple IIc." 2023. In Wikipedia.
196. "'Snow White' Design and the Device That Made Apple Look Good." 2022. Cybernews. April 22, 2022.
197. Wagner, Timo. 2023. "Speculative Interfaces." Medium. March 15, 2023.
198. "Affective Computing." n.d. MIT Press. Accessed May 11, 2023.

alternative modes of interaction, enabling users to interact with digital systems through spatial movements, gestures, brain signals, physical objects, or voice commands. These interfaces often aim to bridge the gap between the physical and digital worlds, providing users with more intuitive and natural ways to control and manipulate digital content. This represents an emergent challenge to Global Design Systems and any systemic guideline creation and application, and is therefore a relevant field of research that can be seen on a close horizon of further development.

Neoteric interfaces push the boundaries of traditional design approaches, focusing on user-centered design principles, enhanced interactivity, and seamless integration of technology into users' daily lives. They strive to create interfaces that are more immersive, adaptive, and responsive, providing users with personalized and contextually relevant experiences. An ubiquitous and invisible application of design principles on every aspect of a user's daily journey. Not only when seating or gazing in front of screens, which seems to be a *constant* in present time.

These interfaces go beyond traditional interaction paradigms and explore novel ways for users to engage with digital systems, leveraging emerging technologies, such as virtual reality, augmented reality, gesture recognition, brain-computer interfaces, tangible user interfaces, and natural language processing, to create immersive, intuitive, and engaging user experiences.

Delving into a concept of immersion, and focusing on just one of the emerging technologies mentioned above, we can take brain-computer interfaces (BCIs).

"The most flexible BCIs of the future will likely be bidirectional, though this flexibility will likely come at the cost and

A work of art is no longer considered the material and intellectual product of an individual human subject, but rather, a dynamic assemblage of multiple agencies and processes that disrupt and interfere with one another within an ontologically heterogeneous field of relations[200]

"As design expands into the social sector, and engages with problems within complex socio-technical systems, it is vital that we reflect on the basic assumptions that have underpinned earlier methods, models, and frameworks, and consider the relevance of emerging social theory."[201]

the associated risk of being invasive."[199]

As we explore the possibilities of invasive peripheral devices that enable bidirectional BCIs, a new array of challenges emerges. These challenges are rooted in the idea that the use of such devices blurs the boundaries between humans and technology, paving the way towards concepts such as post-humanism. Post-humanism challenges the traditional notion of human subjectivity and highlights the interconnectedness of humans and their technological creations.

The creation of BCIs and the interfaces they enable goes beyond the realm of individual human agency. Instead, it encompasses a complex interplay of various actors, processes, and relationships that shape the design, development, and use of these technologies.

In this context, the glimpse of invasive peripheral devices and bidirectional BCIs indicates a direct path towards post-humanism, where the boundaries between humans and technology become increasingly blurred. It challenges our understanding of human identity, agency, and the impact of technology on our lives. It prompts us to question the nature of human creation, as well as the broader implications for society and culture. This suggests discussion that extends beyond the realm of technology and interfaces, touching upon issues of identity, autonomy, power dynamics, and the potential for social inequalities.

10.3.1. REMINISCENT CONTENT

High-resolution image reconstruction with latent diffusion models (LDMs) from human brain activity are proposed in a recent study.

This "study proposes a promising method for

199. Rao, R. (2013). Bidirectional and Recurrent BCIs. In Brain-Computer Interfacing: An Introduction (pp. 221-236).
200. Rousell, David, and Fiona Fell. 2018. "Becoming a Work of Art: Collaboration, Materiality and Posthumanism in Visual Arts Education." International Journal of Education Through Art 14 (1): 91–110.
201. Forlano, Laura. 2017. "Posthumanism and Design." She Ji: The Journal of Design, Economics, and Innovation 3 (1): 16–29.

reconstructing images from human brain activity, and provides a new framework for understanding DMs"[202]

In this research, the authors described their diffusion model (DM), a pioneering approach that utilizes functional magnetic resonance imaging (fMRI) to extract images from human brain activity. This breakthrough allows for the *visualization of thoughts*, opening up intriguing possibilities for future interfaces.

As a possible outcome, one can imagine a scenario where a user is browsing a web page of a new electric vehicle (EV), and the interface generates imagery that aligns precisely with the user's recent dreams of driving along a *beautiful coastal road*. This level of integration between personal thoughts and digital content introduces the concept of reminiscent content, where user experiences are intertwined with their own mental imagery.

This innovative approach could revolutionize hyper-personalization by aligning content with the unique needs and desires of individuals. Hyper-personalization and co-creation push even further the potential of reminiscent content powered interfaces, the concept of co-creation is mentioned in the work of Geetika Jain et al.[203]

Tapping into reminiscent content interfaces could build a real emotional connection between brands and people by bringing products with hyper-personal experiences and images in symbiotic harmony.

Ultimately, connect people with people.

"'Co-creation' concept has defined that a company and its customers are mutually linked to each other to create unique services and products for the personalized benefits to customers and customer plays the role of a co-creator in this process"[204]

202. Takagi, Yu, and Shinji Nishimoto. 2022. "High-Resolution Image Reconstruction with Latent Diffusion Models from Human Brain Activity | BioRxiv." 2022

203. Jain, Geetika, Justin Paul, and Archana Shrivastava. 2021. "Hyper-Personalization, Co-Creation, Digital Clienteling and Transformation." Journal of Business Research 124

204. Jain, Geetika, et al. P. 12–23.

11. CONCLUSIONS

This dissertation has pursued an in-depth investigation of the evolving paradigm of design systems in creative ecosystems, focusing on their capacity to foster creativity and innovation while promoting efficiency and coherence. The goal was to understand the characteristics of these systems, how they interact and facilitate multidisciplinary collaborations, and their impact on the products, services, and teams involved in these collaborative networks. Central to this investigation was the concept of a Global Design System and its potential to integrate various sources of truth in a harmonious and accessible manner, as well as the role of the spaces theory in reinforcing this framework.

In the pursuit of this understanding, the dissertation has extended the current concept of a design system, proposing that it is more than just a set of components or standards, but rather a dynamic ecosystem that enhances and is influenced by the collective intelligence and joyful collaboration of its members. The design system is not a static artifact, but a living and evolving entity, which is adapted and reorganized in response to the changing needs of its users, contributors, and the market.

The importance of the multiplicity of sources of truth has been emphasized in the context of design systems. This multiplicity acknowledges that unique perspectives and methodologies exist within different disciplines, and it recognizes these variances as strengths that can enhance creativity and innovation. The spaces theory has been proposed as a framework that reinforces this

concept, providing a mechanism for integrating these varied perspectives while maintaining clear boundaries of expertise.

In the context of GDS, the convergence of this multiplicity of sources of truth allows all contributors in the creative ecosystem to leverage the unique perspectives and approaches of different fields. It also enables them to create a more cohesive and effective design system, providing a shared context, shared ownership, and promoting real-time collaboration through the methodologies of metadesign. Thus, the dissertation has highlighted the importance of maintaining an open-ended and adaptable framework that can accommodate the dynamic nature of creative processes.

The role of the designer in these systems has also been critically evaluated. In the context of such dynamic systems, the designer is not just a contributor, but also a catalyst for creative value. The designer injects innovation and sparks transformations that ripple through the such networks, affecting and reshaping the trajectory of the entire system. This is a critical role that has significant implications for the evolution and scaling of these systems.

To further enhance this understanding, the dissertation has delved into the concept of metadesign and its application in the design of the architectures and interdependencies of development environments. The idea of metadesign, as it applies to the systemic gesture in design and communication, was assessed. Furthermore, the text explored how various disciplines, such as communication design, contribute to the creation of robust design systems.

By recognizing the diverse nature of contributors in a system—be they designers, engineers, executive stakeholders, or end-users—the dissertation

affirms the importance of cross-disciplinary contributions and collaborations. The interconnections between these disciplines and the resulting impact on the production and delivery flow of these systems were scrutinized.

To provide a practical perspective, this study also brought in comparisons with historical developments in production systems, such as the mobile factory production line introduced by Henry Ford in 1913. Analogies were drawn to highlight the changing dynamics of contemporary design systems, particularly in terms of their flexibility, adaptability, and customization to enhance individual performance.

Finally, this work underscored the crucial role of design in the current societal landscape, which is increasingly interconnected and technology-driven. The complexities and challenges involved in the systematization and optimization of creative processes necessitate the development of robust, adaptable platforms for collaboration across disciplines. The need for design-driven vision and strategy is paramount as the way forward in achieving an optimized and organically evolving procedural response and delivery methodology.

To ensure the successful implementation of the insights and strategies proposed in this study, the importance of testing and validation through case studies has been emphasized. Future research may focus on further elaborating the spaces theory, as well as on the exploration and evaluation of other frameworks and tools that could support the development of Global Design Systems. Such studies could provide valuable contributions to the advancement of design systems, shaping their future trajectory and impact on society at large.

Finally, this dissertation contributes to the understanding and evolution of design systems as dynamic ecosystems that are integral to the future of creative and technological industries. The concept of a Global Design System, the role of multiplicity of sources of truth, and the spaces theory all provide innovative insights into the operation and potential of these systems. As society continues to evolve in an increasingly digital and interconnected direction, the principles and theories discussed here will remain central to our understanding of the role of design in facilitating innovation, creativity, and efficiency.

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